SCIENCE ABSTRACTS.

Section A.—PHYSICS.

AUGUST, 1927.

GENERAL PHYSICS.

2192. *Determination of Gas Density with the Displacement Balance. Part II. Ethylene as a Comparison Gas.* **A. Stock** and **G. Ritter.** (Zeits. phys. Chem. 126. 3–4. p. 172, April, 1927.)—The value previously given for the weight of a litre of ethylene at 0° C. and 760-mm. pressure [Abstract 522 (1927)] requires modification owing to a mistake in the calculation and to bring it into line with Baxter and Starkweather's value for the density of oxygen [see Abstract 1235 (1927)]. The new value is 1·26026 grammes. T. H. P.

2193. *Telescopic Dynamometers.* **R. Guillery.** (Comptes Rendus, 184. pp. 928–930, April 11, 1927.)—Dynamometers used for measuring tension and compression and depending upon the deformation of a ring-shaped member have the disadvantage that the whole of the metal is not efficiently utilised and that internal stresses may exist. The author aims at overcoming these defects by choosing the theoretically most perfect form of spring in which all the fibres perpendicular to the base work uniformly in compression or tension. His dynamometer takes the form of a number of concentric tubes of equal cross-sectional area so arranged that alternate tubes are in compression and tension respectively, the total relative displacement of the ends of the outermost and innermost tubes being transmitted to the pointer of a dial indicator. W. H. G.

2194. *A Tilting Friction Machine.* **P. E. Shaw.** (Journ. Sci. Instruments, 4. pp. 222–226, April, 1927.)—The apparatus is an improved form of one described by the author and C. S. Jex [see Abstract 2423 (1926)] for measuring the coefficient of friction of solid rods, as the surfaces of these are prepared in various ways. Instead of observing, as is usual, the tangential and normal stresses for statical friction, the table carrying the rods is tilted until sliding occurs at a critical angle, θ. The peculiar features of the device are: (*a*) the identical rubbing parts are maintained as the table is tilted repeatedly to one side and then to the other; the rods are guided by stops so as to have only one degree of freedom, and are not handled throughout the whole series of rubs; (*b*) the upper sliding rod is supported equally by the lower one (which is rubbed) and by a thread; (*c*) as rods are used, it is possible to experiment on a great variety of commercial or prepared material, and to clean or otherwise treat the surfaces very thoroughly. In use the apparatus works quickly and reliably, and for some purposes, *e.g.*, for friction work *in vacuo*, should prove invaluable. AUTHOR.

2195. *Apparatus for the Measurement of Atmosphere Turbulence.* **M. Holtzmann** and **L. Keller.** (Phys. Zeits. 28. pp. 304–308, April 15, 1927.)—An instrument, called a turbulimeter, has been devised to measure simultaneously the effect of the mean wind blowing and the oscillations about that value. It consists of two cup anemometers rotating about the same axis, of which one is connected to a permanent magnet and flywheel and thus acquires a high moment of inertia, while the other is connected to a light armature and has a small moment of inertia. In a steady wind both rotate at a constant rate, and no current is generated in the armature. With turbulent motion different rates are acquired, and the current generated is led from the armature to a coil immersed in toluol contained in an enclosed differential calorimeter. The rate of rise of temperature is measured, and this gives a numerical indication of the turbulence existing in the air current. A series of instruments would be needed to work over different ranges of wind velocities. R. S. R.

2196. *The Distribution of Normal Pressures on a Prolate Spheroid.* **R. Jones.** (Roy. Soc., Phil. Trans. 226. pp. 231–266, March 7, 1927.)—Comparison between experimental and calculated results of the normal pressure at points on the surface of a prolate spheroid of length/diameter ratio 4, showed good agreement for three-quarters of the length of the model, and led to the present series of more comprehensive experiments in which the scope of the investigation was widened to cover not only rectilinear motion which is reproduced in wind-tunnel experiments, but to include purely rotational motion (spin about a minor axis) and also motion in a circle. The corresponding theoretical analysis is given. H. H. Ho.

2197. *Motion of a Viscous Liquid Round a Thin Disc vibrating about its Axis.* **I. Kobayashi.** (Zeits. f. Physik, 42. 5–6. pp. 448–474, 1927.)—By elaborate mathematics, an approximate formula for the logarithmic decrement of the vibrations is obtained, differing from that of Meyer. Applied to Meyer's experimental results, however, it does not give so good a value of the coefficient of viscosity. W. G. B.

2198. *Refinement of the Eötvös Reflection Method for the Measurement of Surface Tension.* **H. Moser.** (Ann. d. Physik, 82. 7. pp. 963–992, April 29, 1927.)—This paper contains an investigation of the Eötvös reflection method, and, by means of two changes in the experimental procedure, it has been found possible to remove previous sources of error and so arrive at a means of determining an absolute value for the surface tension of water free from objection. Complete agreement with the data given by the capillary balance or rupture method of Lenard [see Abstract 2413 (1924)] has been recorded. H. H. Ho.

2199. *Absolute Value of the Surface Tension of Pure Water by the Rupture Method and its Dependence on the Temperature.* **H. Moser.** (Ann. d. Physik, 82. 7. pp. 993–1013, April 29, 1927.)—This paper describes an improved form of the apparatus for the determination of surface tension by Lenard's rupture method [see Abstract 2413 (1924)], and its application for the evaluation of the temperature dependence of the surface tension of pure water between 0° and 100° C. Special devices are described for avoiding any difference of temperature between the water surface and its environment. At 18° C. the value is 7·431 mg./mm. A comparison is included between the data afforded by this method and that from the reflection and capillary rise methods. H. H. Ho.

2200. *Supplement to Previous Work on the Resistance Law of Rapidly Moving Spheres in Water.* **W. Bauer.** (Ann. d. Physik, 82. 7. pp. 1014–1016, April 29, 1927.)—In a previous paper [see Abstract 1989 (1926)] the resistance has been evaluated for spheres moving in water with velocities of 150–650 m./sec., from which the resistance law $W = \psi\rho F v^2$ was found to be valid. As a result of private criticism by Ackeret, the author has made the present supplementary contribution to afford a more exact quantitative representation of the current picture in water at these high velocities, and finds the calculated resistance constant $\psi = 0{\cdot}135$, which is not far from the experimental value $\psi = 0{\cdot}15$. H. H. Ho.

2201. *Thermodynamical Theory of Capillarity.* **J. W. Dekker.** (Ann. d. Physik, 82. 8. pp. 1077–1155, May 12, 1927.)—The elucidation of the relationship between surface tension and temperature forms the fundamental basis for a theory of capillarity. The influence of density, entropy, and kinetic pressure on the theory and their consequences are discussed. The subject is primarily reviewed from van der Waals' equation for the equilibrium of a liquid in contact with its vapour and is traced to establish the present theory. The theory is later tested by the application of experimentally found values. S. G. B.

2202. *What Determines the Resistance and Tilt of an Aeroplane.* **J. Larmor.** (Cambridge Phil. Soc., Proc. 23. pp. 617–630, April, 1927.)—Considers some results obtained by applying the principle of conservation of momentum to the field surrounding a body, such as an aerofoil, anchored in a stream of air. Such a body, if free to alter its tilt and speed, produces a double trail of vortices, one starting from near the edge and the other from the near portion of the back surface of the foil. The application to the Lanchester-Prandtl discussions of the problem is described. J. W. T. W.

2203. *Calculation of the Solidity of Rotating Conical Discs.* **E. Honegger.** (Zeits. Math. u. Mechanik, 7. pp. 120–128, April, 1927.)—This calculation is rendered difficult by the circumstance that the differential equation upon whose solution the problem depends cannot be integrated by the usual functions but leads to infinite (hypergeometric) series. Accordingly, special approximations have been proposed which are valid for the practical purposes concerned. A more rigid general solution is now derived. § 1 derives the fundamental equation. § 2 gives the integration of the reduced differential equation. § 3 derives the particular integral of the complete differential equation. § 4, § 5 and § 6 consider special types of disc. The paper is well illustrated by curves. H. H. Ho.

2204. *Forced Oscillations of a Linear Harmonic Oscillator.* **H. Schmidt.** (Zeits. f. Physik, 42. 1. pp. 43–59, 1927.)—From the solution of the differential equation of the forced oscillations of a linear harmonic oscillator, obtained by an application of the integration procedure of Cauchy, a periodic function of the time has been split off, which, on the assumption of an absolute integrable disturbance function, is continuous and continuously differentiable, and can be developed accordingly into an absolute and uniformly convergent Fourier series. This series agrees with the trigonometrical series which is obtained by the usual integration procedure from the Fourier series of the disturbance function, and without regard to convergence (theory of R. Weyrich). For the case of a collision excitation, the solution of the oscillation equation may be obtained in such a form that the special oscillations renewed at the beginning and end of each impact are immediately obtainable. H. H. Ho.

2205. *Special Value Problems on Differential Equations with Interrupted Constant Coefficients. Part I.* **M. J. O. Strutt.** (Zeits. f. Physik, 43. 1–2. pp. 47–55, 1927.)—The author describes a method which enables the special values for differential equations with interrupted constant coefficients to be exactly determined by consideration of a determinant. The method is applied to the transverse oscillations of a string, and also to the torsional and transverse oscillations of a rod. H. H. Ho.

2206. *Phenomena Depending on the Change of Elastic Frequencies in Solid Bodies with Pressure.* **F. Zwicky.** (Phys. Rev. 29. pp. 579–587, April, 1927.)—Born's theory of the constituent forces in heteropolar crystals is adopted. As a new conclusion of this theory a formula for the shift of frequencies of residual rays with pressure is deduced. The shift corresponding to a pressure of 10,000 atmospheres amounts approximately to 7μ in the case of NaCl (residual rays at 50μ). Qualitative conclusions are drawn with respect to the dependence of elastic frequencies on pressure in any crystal. This leads to a rational explanation (suggested at first by Grüneisen) for the effect of pressure on the specific electric conductivity of metals, this conductivity being in general increased by pressure. The relation of the results obtained by the author to those obtained by Grüneisen and Bridgman previously is discussed in quite a different way. AUTHOR.

2207. *A Theoretical and Experimental Contribution on the Nature of Anisotropic Liquids.* **V. Fréedericksz** and **A. Repiewa.** (Zeits. f. Physik, 42. 7. pp. 532–546, 1927.)—From the behaviour of a homogeneously orientated layer of an anisotropic liquid in the magnetic field, the authors have sought, by means of optical observations, to obtain information with respect to the effective forces within such layers. The work of Szivessy is discussed [see Abstract 50 (1926)] and Ornstein's theory which was based on Kast's experiments has been modified from the results of diamagnetic phenomena. The latter enable the forces at the surface of the layer to be calculated. It has been established that the magnetic field influences all types of anisotropic liquids. H. H. Ho.

2208. *Atomic Lattices and Dimensions.* **J. K. Morse.** (Nat. Acad. Sci., Proc. 13. pp. 227–232, April, 1927.)—The cubic atom proposed by

Lewis and developed by Langmuir is extended to simple polyhedrons inscribable in spheres and it is shown how these simple models can be built up into various types of observed cubic and hexagonal lattices. The geometrical relation of lattice constants and atomic radii is discussed and possible atomic radii are computed and tabulated. W. H. Ge.

2209. *Crystalline Structure.* **G. Natta.** (Accad. Lincei, Atti, 5. pp. 592–597, April 24, 1927.)—Crystalline structure of $CrCl_3$ worked out by various methods. It belongs to the rhombohedric system and very probably to the holohedric class; it has an elementary cell containing one molecule of $CrCl_3$ of side $a = 4{\cdot}42$ Å., and an axial ratio $c/a = 1{\cdot}29$ to $1{\cdot}30$. The calculated density is 2·71. A. D.

2210. *The Recrystallisation after Rolling of Face-Centred Metals. Parts I and II.* **F. v. Göler** and **G. Sachs.** (Zeits. f. Physik, 41. 11–12. pp. 873–906, 1927.)—The rolled texture of aluminium was determined from an examination of thirteen X-ray photographs taken in different directions. Approximately it was found that a [335] axis lay along the direction of rolling and a [135] plane lay parallel to the rolled face. These results are in good agreement with those found by other investigators of face-centred metals. After cold rolled copper was annealed it was found that a cubic plane lay parallel to the rolled face and a cubic axis to the direction of rolling. In favourable circumstances the "spreading" was less than 10°. The arrangement was very sensitive to small changes in the amount of foreign matter and to preliminary treatment. The time and temperature of annealing affected only the grain size and the range of "spreading." A. A. D.

2211. *Recrystallisation of Metals.* **R. Karnop** and **G. Sachs.** (Zeits. f. Physik, 42. 4. pp. 283–301, 1927.)—A fully illustrated account of a study by the methods of X-ray crystallography of recrystallisation in aluminium crystals and copper sheet. W. H. Ge.

2212. *Recrystallisation and Softening of Alloys of the Noble Metals.* **L. Sterner-Rainer.** (Zeits. f. Metallkunde, 19. pp. 149–153, April, and pp. 245–248, June, 1927.)—The measurements of the crystal size and X-ray spectra of cold worked and annealed metals and alloys have not resulted in a general clearing of the mechanism of the recrystallisation and removal of hardness. When alloys of the noble metals were subjected to heat treatment at moderate temperatures, an increase in strength was observed, and measured. This is shown by silver alloys and to a greater extent by gold alloys. The microstructure showed no formation of a second phase under the heat treatment, and the phenomenon is a new one and up to the present unknown. F. J. B.

2213. *Recrystallisation Phenomena in Aluminium.* **A. E. van Arkel** and **M. G. v. Bruggen.** (Zeits. f. Physik, 42, 11–12. pp. 795–806, 1927.)—In a previous paper it was shown that the recrystallisation centres are identical with the transformation centres [Abstract 1990 (1927)], being places of greatest lattice energy. Investigations with aluminium show that the number of such centres increases with deformation. The absence of recrystallisation with small deformation is due to a very small velocity of transformation. The general principle is laid down that deformed crystals cannot grow at the expense of surrounding material, which is more deformed. J. E.

2214. *Aluminium Crystals.* **G. Sachs.** (Zeits. Vereines deutsch. Ing. 71. pp. 577–584, April 23, 1927.)—A useful summary with many illustrations and fifty-two references to original papers dealing with the physical properties of aluminium crystals. W. H. Ge.

2215. *The Crystal Structure of Thallium.* **K. Becker.** (Zeits. f. Physik, 42. 5–6. pp. 479–480, 1927.)—Three different results have been obtained for this element. Becker and Ebert found that its crystals are tetragonal, Levi that they are hexagonal with closest packing, and terpstra tetragonal, but with different dimensions from Becker and Ebert. The Debye-Scherrer diagrams employed are not sufficient to decide between the different results. The author here gives the lines and their intensities for a hexagonal lattice with closest packing and with one kind of atom. The intensities have been measured for osmium, which has about the same absorbing power as thallium, and are also calculated from the structure factor. Of 21 thallium lines, only 5 have the intensities corresponding to hexagonal closest packing. There are other discrepancies. H. N. A.

2216. *Symmetry of Atoms in Crystals.* **K. Herrmann.** (Zeits. f. Physik, 42. 8. pp. 631–636, 1927.)—Claims that it is not necessary to assign hexagonal symmetry to the atoms or atomic ions in any substance so far examined by the methods of X-ray crystallography. W. H. Ge.

2217. *Structure of Hard-drawn Wire.* **E. Schmid** and **G. Wassermann.** (Zeits. f. Physik, 42. 11–12. pp. 779–794, 1927.)—A discussion of the X-ray methods used in this type of work is given, together with the results of their application to wires of Al, Cu, Pd, Ag, and Au. W. H. Ge.

2218. *Surface Energy of Rock-Salt Crystals.* **W. D. Kusnezow** and **W. M. Kudrjawzewa.** (Zeits. f. Physik, 42. 4. pp. 302–310, 1927.)—The surface energy of the (100) plane of rock-salt crystals has been determined experimentally by the cleavage method, and the results are of the same order of magnitude as the theoretical value ($\sigma_{(100)} = 1\cdot5$ erg/mm.^{2}). W. H. Ge.

2219. *Carbon Atom Model and Structure of Diamond.* **R. B. Lindsay.** (Phys. Rev. 29. pp. 497–509, April, 1927.)—Four 2_1 orbits are assumed and are computed on the basis of orientation in orbital planes with assigned phase relations. The aphelion distance is $2\cdot00a_0$ while that deduced from the atomic volume is $2\cdot06a_0$. The orbital energies vary according to the screening assumption. The one adopted gives $0\cdot76e^2/a_0$. Introducing such a model into the diamond lattice, the force on an electron and the energy for various values of the lattice constant are calculated. The calculated heat of sublimation is 121 kg.-cal. per mol. and the experimental values are between 168 and 177. A. Wh.

2220. *Atomic Theories.* **O. W. Richardson.** (Phys. Soc., Proc. 39. pp. 171–186, April, 1927.)—An account of recent theories of atomic physics; the quantum theory and its development by Heisenberg and others, de Broglie, and Schrödinger. The relation of these theories to experimental facts and difficulties is indicated. A. Wh.

2221. *Band Spectra and the Periodic Classification of the Elements.* **R. Mecke.** (Zeits. f. Physik, 42. 5–6. pp. 390–425, 1927.)—The structures of band spectra are correlated with the positions of the respective elements in the periodic classification, from a consideration of 100 band systems associated with 68 different molecular combinations, comprising hydrides, oxides and nitrides, molecules of the elements, and halogen compounds. The analysis is based upon a determination of nuclear moments of inertia and distances, characteristic nuclear frequencies, and the separation of electron terms. Assuming an expression for the potential P in the form $P = -[(C_1/r^p) - (C_2/r^q)]$, it is shown that for the hydrides $p = 1$, whilst q has values between 3 and 4. For other combinations, p has the values 3 to 4, and q the values 6 to 10. J. S. G. T.

2222. *Significance of Molecular Spectra. Part II.* **F. Hund.** (Zeits. f. Physik, 42. 2–3. pp. 93–120, 1927.)—In this paper the basis for a systematic study of molecular spectra given previously [see Abstract 1271 (1927)] has been applied to the theoretical investigation of a series of such spectra. An earlier summary of fine structures has been analysed and supplemented whereby agreement with similar empirical work by Mulliken and Birge has been established. The rules for the arrangement of the term scheme of a molecule with two unlike nuclei, and also the combination rules, have been investigated for the spectra of BO, CO^+, CN, CO, CaH. For molecules with two like nuclei the symmetry of the stationary states with respect to the nuclei has to be taken into account, and by this means an explanation for certain empirical combination rules and for the different types of intensity change in bands has been obtained. Terms for the H_2-molecule are given as an example of a term scheme, and the considerations advanced have rendered possible a theoretical derivation of the specific heat curve for hydrogen. H. H. Ho.

2223. *A Minimum Property of the Schrödinger Wave Groups.* **A. Markoff.** (Zeits. f. Physik, 42. 8. pp. 637–640, 1927.)—In this mathematical note the Schrödinger wave packets corresponding to the harmonic oscillator are derived as a minimum characteristic. H. H. Ho.

2224. *Magnetic Dipole in Undulatory Mechanics.* **P. S. Epstein.** (Nat. Acad. Sci., Proc. 13. pp. 232–237, April, 1927.)—A theoretical paper giving a method for the computation of the characteristic values of the parameter contained in linear differential equations, which is applicable in certain cases when the equation cannot be reduced to the hypergeometric type. The procedure is illustrated by treatment of the motion of an electron in the combined fields of a nucleus and of a magnetic dipole attached thereto. Two of the formulæ completely represent the effect of the spinning electron as it was suggested by Goudsmit and Uhlenbeck. W. H. Ge.

2225. *Quantum Mechanics Interpretation of Weyl's Theory.* **F. London.** (Zeits. f. Physik, 42. 5–6. pp. 375–389, 1927.)—Weyl's theory and de Broglie's wave mechanics are briefly reviewed, and the natural gauge, l, of the former identified with the wave function, ψ, of the latter theory. Objections to this identification are considered. More especially it is shown that non-integrability of expressions involving l does not exclude the identification from being unequivocal. The conception is applied to the quantum interpretation of Weyl's theory. J. S. G. T.

2226. *Kaluza's Theory of the Correlation of Gravitation and Electricity. Part I.* **A. Einstein.** (Preuss. Akad. Wiss. Berlin, Ber. 6. pp. 23–25, 1927.)—It is shown that in Kaluza's unitary theory of the gravitational and electromagnetic fields [see Abstract 693 (1922)], based upon the assumption of the existence of a five-dimensional Riemannian continuum satisfying a certain cylindrical condition, whereby the continuum becomes four-dimensional in form, beside the symmetric tensor (g_{mn}) of the metric, only the antisymmetric tensor (ϕ_{mn}) derivable from a potential function is significant as regards the electromagnetic field. J. S. G. T.

2227. *Kaluza's Theory of the Correlation of Gravitation and Electricity. Part II.* **A. Einstein.** (Preuss. Akad. Wiss. Berlin, Ber. 6. pp. 26–30, 1927.)—Kaluza's theory [see Abstract 693 (1922) and preceding Abstract] is shown to afford a rational derivation of Maxwell s electromagnetic equations, and to correlate these with the gravitational equations. A similar deduction has been made by Klein [see Abstract 2541 (1926)]. J. S. G. T.

2228. *General Theory of Relativity and the Law of Motion.* **A. Einstein** and **J. Grommer.** (Preuss. Akad. Wiss. Berlin, Ber. 1. pp. 2–13, 1927.)—It is shown that in the general theory of relativity the law of motion is completely determined by the field equations if masses in the gravitational field can be conceived as singularities. If an approximation to the complete field be derived by approximating to the solution of a series of linear equations, then the formal representation of the law of motion is the same as that of the geodetics. The theory developed, being based on the existence of singularities, may be of significance in the development of the quantum theory. J. S. G. T.

METEOROLOGY AND GEO-PHYSICS.

2229. *Measurement of the Height and Thickness of the Ozone Layer in the Atmosphere.* **J. Cabannes** and **J. Dufay.** (J. de Physique et le Radium, 8. pp. 125–152, March, 1927.)—From measurements of the absorption of solar radiation at different heights above the ground the absorption curve is extrapolated to zero pressure and the resultant effect ascribed to ozone. This difference is equal to that obtained for an ozone layer of 0·3 cm. thick. The ozone was found to be largely confined to the regions outside the layers where diffusion occurs. Since difficulties exist in measuring solar radiation at sunset owing to the absorption of many wave-lengths, molecular diffusion, parasitic radiations and the effects due to irregular refraction, dust particles and mist, measurements were made of the radiation from the blue sky at the zenith. A Hilger quartz spectrograph was used giving a dispersion of 20 Å./mm. between $\lambda = 3350$ and 3400 Å. and of 15 Å./mm. between $\lambda = 3100$ and 3150 Å.

From these measurements of the brightness of the sky they have established that the distribution of energy in the spectrum of the blue sky varies very little in the course of the day if allowance is made for the ozone, and from measurements with different altitudes of the sun they verified to a certain degree the calculations of V. King. The ozone layer was found to lie between 45 and 50 km. R. S. R.

2230. *Isostasy.* **W. Bowie.** (Washington Acad. Sci., J. 17. pp. 101–117, March 4, 1927.)—The paper provides a brief summary of the results of isostatic investigations and of their application in the spheres of geodesy and geology. W. A. R.

ASTRO-PHYSICS.

2231. *Report on the Total Solar Eclipse of* **1926,** *January* **14. C. R. Davidson** and **F. J. M. Stratton.** (Roy. Astron. Soc., Mem. 64. 4. pp. 105–148, 1927.)

2232. *The Infra-Red Solar Spectrum with the Interferometer.* **H. D. Babcock.** (Mt. Wilson Observat. Contrib. No. 328. Astrophys. J. 65. pp. 140–162, April, 1927.)—The solar spectrum in the interval λ6868–λ8980 has been photographed on plates sensitised with neocyanin through interferometers crossed with a concave grating. The methods and apparatus used are described, and also some of the precautions taken to avoid instrumental errors. The wave-lengths of 507 lines (Table II) were measured in terms of oxygen band lines due to terrestrial absorption, and are expressed on the neon scale. Of the 507 lines measured, 176 are of solar origin; most of the remainder are probably lines of terrestrial water vapour. The measurements have been used for a revision of the identification of solar lines, but refined laboratory wave-lengths are much needed for further work. The more prominent solar lines still awaiting identification are listed in Table IV. In the absence of precise laboratory data for vacuum spectra in the infra-red, the new solar wave-lengths are compared with interferometer measurements on the spectrum of a short iron arc at atmospheric pressure. This brings out clearly the correlation of multiplet grouping, excitation potential, and behaviour under increased excitation with the combined influence of pressure displacement and pole effect. The data, though not definitive, are consistent with the gravitational displacement predicted by Einstein. AUTHOR.

2233. *Rotation of the Earth.* **H. S. Jones.** (Roy. Astron. Soc., M.N. 87. pp. 4–31, Nov., 1926.)—If the residual errors of the moon's longitude are due in part to a variable rate of rotation of the earth, the variation should be reflected in the motions of the sun and planets. The author discusses the Greenwich observations of the sun, Mercury, Venus, and Mars; for Mercury, he uses both meridian observations (which have small weight) and transit observations; for Venus, meridian observations (of considerable weight). He summarises the evidence in four figures which represent the residual longitude errors of the sun, and of Mercury, Venus and Mars; in the case of the planets the residuals being multiplied by the ratio of the mean motion of the earth to the mean motion of the planet (for Mercury, Venus and Mars the multipliers are 0·241, 0·615 and 1·88 respectively). The curves show similarity, which the author expresses numerically as correlation coefficients, whose high values indicate the common cause as the earth's rotation rate. He compares a composite of these four curves with that of Dyson and Crommelin's minor fluctuations of the moon, and concludes that these latter can also be attributed to irregular variations in the earth's rotation. [See next Abstract.] A. S. D. M.

2234. *Trepidation. Parts I and II.* **J. K. Fotheringham.** (Roy. Astron. Soc., M.N. 87. 142–167, Dec., 1926, and pp. 182–196, Jan., 1927.)—The author computes for 1843–1925 the epochs and mean motions of the sun and moon, ignoring all empirical terms, and inferring that in this period their deviations approximate to a constant ratio, and the two orbits may be brought into agreement by correcting the solar elements for two quantities only. He finds in the first paper an empirical secular acceleration to the sun's mean motion of $+ 1''\cdot 29$, corrected in the second paper to $+ 1''\cdot 36$; and also a real minor periodicity of about seventy years. He claims for the mass of Venus the same fluctuation as in the sun and moon, deducing the mass from inequalities of the sun and Mars, and concluding that it varies inversely with the change of the lunar fluctuation, and is real. The earth's rotation is not affected by a fluctuation, though there may be secular retardation. From Venus, he finds for the solar acceleration, $+ 1''\cdot 49 \pm 0''\cdot 43$. The Equinox fluctuation is found to be in the same direction, but less than three-fourths that in the sun's longitude. He defines "trepidation" as a change by jerks. [See Abstract 22 (1915).] A. S. D. M.

2235. *On J. K. Fotheringham's Paper entitled "Trepidation."* **E. W. Brown.** (Roy. Astron. Soc., M.N. 87. pp. 524–527, May, 1927.)—The author shows that Fotheringham's assumption [see preceding Abstract] of a periodic change of the mass of Venus cannot hold on account of gravitational reasons. If δL and $\delta\mu'$ be the changes in the true longitude and the ratio of the mass of Venus to that of the sun, then if the change of eccentricity contains a term with very long period, its effect is almost wholly confined to δL, and a change of 2 % in $\delta\mu'$ would give a coefficient of $7''\cdot 2$, which leaves too great a discrepancy with observation. Also any change in $\delta\mu'$ must have a period nearly equal to $g - g'$ or $2g - 2g'$ (where g and g' are the mean anomalies of the earth and Venus), and a 1 % alteration would give a coefficient of $375'$ for $g - g'$ and larger for $2g - 2g'$, which again is inadmissible. The author attributes Fotheringham's correlation, between the mass of Venus and the apparent fluctuation in the moon's motion, to accident, due to the use of different values of the coefficient of the principal Venus terms used in the tabular material, and justifies this suggestion by quotations from Newcomb's *Astronomical Constants*, pp. 6, 7 and 8. A. S. D. M.

2236. *Moon's Motion.* **W. D. Lambert.** (Washington Acad. Sci., J. 17. pp. 133–139, March 19, 1927.)—E. W. Brown's explanation of apparent fluctuations in the moon's motion involves an expansion and contraction of the earth over irregular periods of years. This change need not be uniform, but must have an adequate average value, and would be very convenient for explaining irregularities in the variation of latitude, especially the "free" period of fourteen months. There is, of course, at present no explanation of such pulsations of the earth. The interesting point is that there seems to be a possibility of a close connection existing between the irregularities in the motion of the moon and irregularities in latitude variation. It may be noted that Evans' explanation that the moment of inertia change is due to shifting of load by increases and decreases of the polar ice caps also fits the latitude puzzle in regard to the magnitude of the quantities involved. W. A. R.

2237. *Relative Effective Temperatures of Twenty-Two Stars of Early Type.* **W. M. H. Greaves, C. Davidson** and **E. Martin.** (Roy. Astron. Soc., M.N. 87. pp. 352–363, March, 1927.)

2238. *Spectroscopic Parallaxes of B-Type Stars (Fourth Paper): Method of Adams and Joy.* **D. L. Edwards.** (Roy. Astron. Soc., M.N. 87. pp. 364–387, March, 1927.)—The method hitherto used at the Norman Lockyer Observatory for determining spectroscopic parallaxes of B-type stars is not applicable to a large number of them, particularly those of the later subdivisions; and the best method seems to be that of Adams and Joy. It is based on the correlation between absolute magnitude and spectral type, combined with a distinction of their spectral lines into "sharp" and "nebulous." The writer points out that this is a question of degree, and he divides each spectral sub-type of B-stars into five classes, passing gradually from those with extremely sharp to those with extremely nebulous lines. The B sub-types are also re-classified according to a system differing slightly from the Harvard system. It is shown that sub-type and line-character can in this way be successfully correlated with absolute magnitude; and the correlation is used to obtain absolute magnitudes and parallaxes of 300 B-type stars. The results are compared with parallaxes from other sources. M. A. E.

2239. *Liquid Stars and Stellar Energy.* **J. H. Jeans.** (Roy. Astron. Soc., M.N. 87. pp. 400–414, March, 1927.)—Investigations of the phenomena of stellar fission indicate that stars behave as liquids, and a theory is put forward on these lines which appears to bear on the observed occurrence of certain spectral types. In a Russell diagram certain areas are congested and others comparatively free from stars. It is suggested that the boundaries of these regions represent the lines along which the ordinary gas laws begin to fail, a separate region occurring for each electronic level. It is assumed that energy generation is independent of density and temperature. A. Wh.

2240. *Pulsation Theory of Cepheid Variables.* **J. J. M. Reesinck.** (Roy. Astron. Soc., M.N. 87. pp. 414–420, March, 1927.)—Eddington has developed a theory of Cepheid variables in which the heat capacity of the outer layers is supposed to cause a lag in phase between maximum density and maximum radiation. It is now shown that the heat capacity is inadequate to explain the coincidence of the times of greatest outward radial velocity and maximum radiation. A. Wh.

2241. *Constitution of Spiral Nebulæ.* **B. Lindblad.** (Roy. Astron. Soc., M.N. 87. pp. 420–426, March, 1927.)—On the stellar theory it appears that the figure of equilibrium will be a Maclaurin ellipsoid until the eccentricity becomes 0·9529. Actually a limit between 0·96 and 0·97 is observed. The arms of a spiral nebula can be explained by the assump-

tion of an attracting spheroid at the centre, and the eccentricity of this is found to be 0·99 for Messier 33 and 0·97 for Messier 81. The equilibrium and differentiation of different star types in such nebulæ is considered.
A. Wh.

2242. *Photographic Magnitude Equation.* **H. Knox-Shaw.** (Roy. Astron. Soc., M.N. 87. pp. 439–446, March, 1927.)—Description of a systematic magnitude equation which has come to light in the course of the proper-motion work now being carried out with the 24-in. refractor at Radcliffe Observatory. Analysis of the results of the first ten completed areas of the proper-motion programme revealed a systematic magnitude equation in both R.A. and declination which is too large to be a real motion of the stars. This has been traced to a change in the optical field of the object-glass, made in 1914 when adjusting its component parts after cleaning, although the usual tests on out-of-focus images showed no change. Attention is drawn to the danger of adjusting an object-glass in the middle of a proper-motion programme, unless very sensitive tests are employed to ensure that there has been no change in the optical field. It is suggested that the usual method of testing by out-of-focus images is not sufficiently sensitive. E. F.

2243. *Errors of Photographic Proper Motions.* **W. M. Smart.** (Roy. Astron. Soc., M.N. 87. pp. 446–458, March, 1927.)—A pair of plates of 6 Cygni, one taken directly and the other through the glass, with only a few days' interval between them, were measured and reduced precisely as if they had been proper-motion plates. The residuals in the usual linear equations are, therefore, free from proper motion and merely the results of accidental and systematic errors. As regards accidental errors, a residual is due to (*a*) the error of measurement of the displacement between corresponding images, and (*b*) errors in the computed plate constants. As regards (*b*), it is shown that when the plate constants are calculated from the measures made on 24 comparison stars the extremely simple method of Christie and Dyson is very slightly inferior to the laborious least-squares solution sometimes adopted, and that when the larger values of the errors (*a*) are considered in combination with (*b*) this slight inferiority practically disappears. The measures were subjected to various tests. In terms of proper motion with an assumed interval of 17·6 years the probable error of a single determination is calculated to be ± 1″·0 per century in each coordinate, and for six separate comparisons the probable error is ± 0″·4 per century. Magnitude error is not evident from the measures in declination, and its possible existence in R.A. has not been consistently demonstrated. E. F.

2244. *Interstellar Domain of Comets of the Earth's Age.* **E. Belot,** (Comptes Rendus, 184. pp. 937–939, April 11, 1927.)—All comets of great or small perihelion distance tend to disappear from several causes, fifty perihelion passages being assumed sufficient to dissipate any comet. The author infers that the continued appearance of comets is due to the size of their orbits, and to their age comparable with the earth. In general, comets must have elliptic orbits with e nearly equal to unity. From the proximity of other stars in past ages, he finds that the aphelion distances of solar comets do not exceed 2 light years, and most are of 1 light year, giving periods of revolution of 15·6 and 5·5 million years respectively, so that in the 330 million years allowed for the age of the solar system, we should not find that all the comets had been yet dissipated. [See also Abstract 2296 (1926).] A. S. D. M.

2245. *Measurement of Stellar Radial Velocities.* **M. Hamy.** (Comptes Rendus, 184. pp. 981–985, April 25, 1927.)—The author describes briefly Hartmann's method, which does not require an exact knowledge of stellar or comparison spectra wave-lengths, but depends on the simultaneous examination of a stellar and a solar spectrogram, both fitted between the laboratory comparison lines obtained with the same spectrograph. These spectrograms are placed in a comparator upon independent supports, and their images are viewed simultaneously in the field of the microscope. In an apparatus proposed for this by the author he introduces on the support two frames fitted with metallic parallel threads, whose thickness is so calculated that the frames are complementary, and he describes an optical system for securing the superposition of the images in the field of the microscope. This reduces the times of exposures but makes the measures less precise, and in order to reconcile these opposing requirements, he proposes to adopt profound modifications of Hartmann's method, and describes these. A. S. D. M.

2246. *Absorptive Power of Stellar Matter.* **S. C. Roy.** (Zeits. f. Physik, 42. 7. pp. 499–515, 1927.)—A mathematical paper in which an expression is given for the coefficient of absorption of radiation by matter under varying conditions of ionisation. It is shown that the absorptive power of stellar matter is greatest in the interior of a star and diminishes towards the surface. According to our present knowledge of stellar absorption the luminosity both of dwarfs and giants increases as their effective temperatures decrease. This conclusion agrees with the condition of the stable equilibrium of stars as deduced by Eddington. E. F.

2247. *Gas Ionisation and Stellar Temperatures.* **G. Tiercy.** (Arch. des Sciences, 9. pp. 87–107, March–April, 1927.)—If n_o, n_i, n_e, p_o, p_i, p are relative numbers and partial pressures of neutral and ionised atoms and electrons, P the total pressure, R the gas constant, and T the absolute temperature, then for dynamical equilibrium, $K = n_i n_e / n_o$, is a function of the temperature; as is also, therefore, $K_p = KRT$. For each value of T, K_p gives the degree of ionisation (ξ), that is, the percentage of dissociated atoms per unit volume, whence the law of mixed gases gives $K_p = P \,.\, \xi^2/(1-\xi^2)$, and the problem reduces to the function $K_p(T)$ or $K(T)$. The author obtains for $K_p(T) : d \log K_p/dT = \Delta U_p/RT^2$, which is equivalent to van t' Hoff's formula, and on integration, $\log K_p = - U_0/RT + (\gamma_i + \gamma_e - \gamma_o) \log T/R + A_0$ [γ being the specific heat], which is the same as Saha's formula in common logarithms for a monatomic gas $(\gamma_i = \gamma_e = \gamma_o = 5R/2) : \log [\xi^2/(1-\xi^2)]P = -U_0/[4 \cdot 571T) + 2 \cdot 5 \log T + A_0M$, where he takes $A_0M = -6 \cdot 5$. The author shows that the value of A_0M should be reduced to $-5 \cdot 5$, and points out (whether or not the gas is monatomic) that $\xi < 1$, and approaches 1 if P is small whatever T may be, or if T increases whatever P may be. He forms tables of ξ in percentages for various temperatures of calcium, sodium, strontium, magnesium, hydrogen and helium. [See Abstract 682 (1921).] A. S. D. M.

2248. *Absolute Magnitude of Giant M-Stars.* **G. Strömberg.** (Mt. Wilson Observat., Contrib. No. 327. Astrophys. J. 65. pp. 108–116, March, 1927.)—For the absolute magnitudes and parallaxes of 410 stars of M type, discussed by Adams, Joy and Humason [see Abstract 601 (1927)], the author determined the reduction curves in the spectra of the giant stars included. In the earlier paper the same reduction curves were used for all spectral subdivisions, but in the present paper he gives the method and formulæ used in deriving these curves and, in addition, supplies appreciably different reduction curves for the different subdivisions. These curves show that the ordinary giants of all subdivisions are of nearly the same visual absolute magnitude; their dispersion is so small that, if separated from the super-giants, which have a much larger dispersion, they could be given a single and the same absolute magnitude, when derived from peculiar motions. He finds that if the absolute magnitudes are computed from parallactic motion, with a solar motion of 23 km./sec., they are brighter by 1·02 for the super-giants, and by 0·49 for the ordinary giants, and compares this discrepancy with that for the long-period variables. The cause of this systematic difference between results, based upon peculiar and parallactic motions, is still obscure. A. S. D. M.

2249. *Interstellar Calcium.* **O. Struve.** (Mt. Wilson Observat., Contrib. No. 231. Astrophys. J. 65. pp. 163–199, April, 1927.)—An interpretation of observational material concerning "detached" calcium lines according to Eddington's hypothesis (that absorption occurs evenly all along the path of the light) and Plaskett's (that absorption is produced in a widely distributed tenuous cloud of matter). The author discusses the intensities of the K line of calcium for systematic, probable and under-exposure errors. He finds for regional effect an abundance of lines, strong in Cepheus, faint in Orion, this difference not being a chance one; also a definite increase in intensity between magnitudes 1 and 7 with distance, favour being shown to the strongest lines by a spherical shell of distance from us of 500 parsecs (the boundary of Charlier's and Shapley's local B-star cluster; the effect of distance is uncertain in O-stars); the space within 200 parsecs of the sun is unfavourable to detached lines; intensity progresses with spectral type (but this may be masked by regional effects), and can be interpreted only as a real effect of stellar radiation or temperature, which is also supported by the fact that detached lines disappear abruptly at subdivision B_3; there is a slight galactic concentration of calcium clouds; in double stars the two components act as one body with respect to calcium gas, and the effective reach of stellar radiation in producing detached absorption lines must be at least one-twentieth of a parsec; calcium velocities differ much from stellar, having small residuals; there is no direct relation in Cepheus between the calcium cloud (distant about 250 parsecs) and the obscuring nebula (beginning about 330 parsecs distance), though one may merge into the other; the calcium cloud is transparent except for monochromatic radiation. The author concludes that Eddington's hypothesis is not tenable in its present form, and that Plaskett's hypothesis is not contrary to his results, but that it is not possible definitely to accept either hypothesis. A. S. D. M.

LIGHT.

2250. *Colour Measurement.* **T. Oryng.** (Phys. Zeits. 28. pp. 298–300, April 15, 1927.)—Continues the criticism of K. W. F. Kohlrausch's method of colour measurement, contained in a previous paper [see Abstract 1332 (1925)], and deals with remarks by E. Schrödinger on the same. The author concludes that the colour of a body is definitely determined by its absorption spectrum, and that for comparison of colours the spectra must be worked up, which involves complications and uncertainty. For this purpose at present there are two equally justified methods, those of Ostwald and of Hübl. Further research is necessary to find out exactly in what degree they serve their purpose. H. N. A.

2251. *Absorption of Light by Ozone between* 3050 *and* 3400 (*Huggins' Region*). **J. Duthell and Madeleine Duthell.** (J. de Physique et le Radium, 7. pp. 414–416, Dec., 1926.)—The positions and values of the maxima and minima of absorption in the Huggins region [Abstract 980 (1913)] are given. The knowledge of the absorption coefficients is used in the study of atmospheric ozone. J. E.

2252. *Measurements of Absorption Coefficients of Light Filters.* **J. M. B. Dobson and I. O. Griffith.** (Phys. Soc., Proc. 39. pp. 223–226, April, 1927.)—A portion of the slit of a spectrograph is covered by the absorbing medium, and a neutral wedge is placed in front of the photographic plate or of the slit. The spectrogram thus consists of two parts, one due to light which has passed through the filter and a portion of the wedge and the other to that which has passed through the thick portion only. With a microphotometer the positions of two points of the same intensity for any wave-length in these two parts are determined, and it is shown how from these measurements the absorption coefficient of the filter for this wave-length can be calculated. The source of light need not be constant. H. N. A.

2253. *Absorption of Optical Glass and Borax below* 4·1 μ. **T. Dreisch.** (Zeits. f. Physik, 42. 5–6. pp. 428–434, 1927.)—Optical glasses ordinarily absorb little up to 2·7 μ, but after that the absorption rises rapidly. If the glass contains boric acid, sharp bands occur at 2·8, 3·68 and 4·05 μ, and the intensities of these bands increase with increasing boric acid content. They correspond to bands in borax at 2·95, 3·65 and 4·1 μ. Silicic acid causes diffuse bands at 2·85 and 3·55 μ. These results were obtained by using a 5·5 cm. fluorite prism of 60° angle, and ten different glasses containing different quantities of boric acid. The apparatus is described at length in Abstract 1056 (1925). A. C. M.

2254. *Transmission of Light through Transparent Plates.* **H. Goldschmidt.** (Ann. d. Physik, 82. 7. pp. 947–962, April 29, 1927.)—On the groundwork of Voigt's theory of the transmission of light through a parallel-faced isotropic transparent plate, formulæ are developed for the light transmitted and reflected by a congeries of two (or three) such plates. The results applied to a platinum film deposited on a quartz plate. A. D.

2255. *Passage of Light through a Transparent Bent Plate.* **E. Henriot.** (Comptes Rendus, 184. pp. 1318–1320, May 30, 1927.)—When a beam of light from a collimator is allowed to fall on a bent plate with parallel faces it is split up into two beams of parallel light which, received in a lens, give two images of the slit if the slit is parallel to the neutral fibres. The plate should be bent by uniformly distributed pressure and the central portion used. The effect is due to the extension of the outer and contraction of the inner layers of the plate. Experiments with plates of xylonite showed the effect unmistakably, and further experiments with a series of bent glass strips enabled Havelock's law to be verified to the degree of accuracy of the experiments. A. W.

2256. *Herschel's Condition; the Optical Cosine Law.* **G. C. Steward.** (Cambridge Phil. Soc., Proc. 23. pp. 703–712, April, 1927.)—Herschel's condition extended by Abbé in the form that spherical aberration supposed zero for two conjugate axial points is stationary for axial variations provided that the incident and emergent rays for two conjugate axial points associated with modified magnification m satisfy the relation $m \sin (\theta'/2) = \sin (\theta/2)$ [Herschel's condition], where θ and θ' are their initial and final inclinations to the axis and by m is meant the ratio of the reduced sizes of the image and object. This brings to mind the well-known sine condition $m \sin \theta' = \sin \theta$, which implies the absence of circular coma of *all* orders for the pair of points in question. The present paper investigates the meaning of Herschel's condition and the meaning of a given departure from it. Both Herschel's condition and the sine condition are included in a much wider result, the optical cosine law [T. Smith, Abstract 1549 (1923)], which contemplates the presence of spherical aberration or, indeed, of any other type of aberration. Herschel's condition, applied to two conjugate points free from spherical aberration, implies that neighbouring axial points are free from spherical aberration of all orders; and conversely. A given departure from Herschel's condition affords a measure of a spherical aberration introduced by a slight axial movement of the object plane. Herschel's condition provides that neighbouring axial points be represented perfectly; the sine condition that neighbouring points in a plane normal to the axis be represented perfectly; these two conditions are incompatible unless $m = \pm 1$. T. Smith's proof of the optical cosine law depends on the Eikonal of Bruns; the author here gives another proof depending on the principle of stationary path, and follows up some particular cases of the law. A. D.

2257. *Theory of the Sextant.* **V. Thelmer.** (Zeits. Instrumentenk. 47. pp. 165–186, April, 1927.)—The author deals first with the essential parts of this instrument and the principle underlying the measurement of angles with it, whether with natural or artificial horizons. He next deals with the conditions required to obtain accuracy of setting, and examines errors due (1) to collimation; (2) to inclination of the fixed mirror; (3) to inclination of the movable mirror, constant and variable; (4) to eccentricity of the movable mirror; (5) to scale graduations, and (6) to the coloured diaphragms not being plane parallel. Methods of determining the errors are explained. R. S. R.

2258. *An Infra-Red Spectrometer of Large Aperture.* **A. H. Pfund.** (Optical Soc. America, J. and Rev. Sci Inst. 14. pp. 337–338, April, 1927.)

—The usual mirror spectrometer for infra-red work makes use of concave reflectors of comparatively small aperture. Though reflection takes place off the optic axis of the concave mirrors, it is possible to produce a sharp spectrum in the position of the primary focal line. But if the aperture be increased greatly, the slit image suffers from the various aberrations to such an extent that the resultant spectrum becomes very impure. These defects have been overcome in the arrangement described and illustrated by drawings which should be consulted in the original paper. E. F.

2259. *Comparison of Three Spectrophotometric Methods.* **L. Taylor.** (Optical Soc. America, J. and Rev. Sci. Inst. **14.** pp. 332–336, April, 1927.) —The results are given of an investigation of the specific exciting power of fluorescence in regions where Stokes' law is violated. The methods studied were (1) the ordinary Lummer-Brodhun spectrophotometer, (2) a spectrograph in which the fluorescence and comparison spectra were photographed simultaneously by means of a divided slit, and (3) a photoelectric spectrophotometer. Of these (1) was found to be totally inadequate for the intensities of light under investigation, while (2) seemed capable of considerably more accurate results, but was cumbersome, and long exposures of 2 to 20 hours were necessary. With (3) exposures of a few minutes only were required. A table summarises the precision attainable for several relative intensities for the three methods. R. S. R.

2260. *A Polarisation Photometer Eyepiece.* **F. E. Wright.** (Optical Soc. America, J. and Rev. Sci. Inst. **14.** pp. 339–341, April, 1927.)—Illustrated description of an instrument constructed primarily as an eyepiece on an astronomical telescope for studying the amount of polarised light reflected from different parts of the moon's surface under different angles of incident illumination. It can, with slight modification, be adapted to other similar problems, wherever it is desirable that the image of the object be viewed in the photometric field at the time of measurement. It consists essentially of a thin negative lens of 150 mm. E.F. cemented to the front end of a calcite Wollaston prism of slope angle 11°. To the opposite end is cemented a thin positive lens of 150 mm. E.F. There are two crown glass biprisms of refractive index $n = 1{\cdot}51$, with slope angles of 7° 30′ and 3° 48′ respectively, also a low-power eyepiece lens and a Glan-Thompson polarising prism. The apex of the second biprism is placed at the focus of the positive lens, where it is viewed in the image plane dividing the field into photometric halves. The first biprism is mounted on a sliding carriage, so that its distance from the second can be changed at will. The converging rays from the telescope objective are rendered parallel by the negative lens. On emerging from the Wollaston prism the parallel pencil is divided into two divergent plane polarised beams with vibrating planes at right angles to each other. Each of the parallel beams is brought to focus by the positive lens in the image plane. The two converging bundles of light are deflected by the first biprism, the foci meeting at or near the apex of the second biprism. The Glan-Thompson polarising prism can be rotated in its mount, and the angle which its principal plane includes with the principal planes of the Wollaston prism at the instant of equal photometric intensity of the two images of the detail on the moon's surface can be read off on a graduated circle. With the principal planes of the Wollaston prism set in correct azimuth the amount and vibration plane of polarised light in the reflected beam can be computed. If the negative lens be removed, the photometer can serve as a low-power telescope. In this form it has been used to measure the amount of polarised light at different points in the sky and in light reflected from land surfaces and vegetation. E. F.

2261. *Optical Constants of Single Crystal Bismuth.* **F. E. Dix** and **L. H. Rowse.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 304–308, April, 1927.)—Previous determinations of optical constants of Bi have been made on the polycrystalline metal. But Bi is optically uniaxial, and consequently should have two sets of optical constants. Using polycrystalline samples therefore gives a kind of average, further upset by polishing. In this work, large single crystals were prepared, and a good surface got by splitting. A table is given of refractive indices, extinction moduli, and computed reflectivities for wave-lengths of 670 $m\mu$ to 350 $m\mu$. A. C. M.

2262. *Rotary Dispersion in the Ultra-Violet of Aqueous Solutions of Tartaric Acid containing Boric Acid.* **R. Descamps.** (Comptes Rendus, 184. pp. 876–878, April 4, 1927.)—In a recent paper [see Abstract 1338 (1927)] the author has given the results of the measurement of the rotary dispersion of three aqueous solutions of tartaric acid, containing an equimolecular quantity or a very small excess of boric acid, these solutions giving curves of rotary dispersion of an anomalous complex type. In consequence of these results further measurements have been made of the rotary dispersion of tartaric and boric acid solutions of very different molecular proportions and using longer wave-lengths. The results of the investigation are presented in tabular form. A. B. W.

2263. *Rotatory Power of Solutions of Tartaric Acid.* **G. Bruhat** and **M. Pauthenier.** (J. de Physique et le Radium, 8. pp. 153–160, March, 1927.)—Solutions of tartaric acid containing only 1 % and 0·25 % of the acid, when examined polarimetrically at wave-lengths down to 3130 Å.U., are found still to exhibit an inflexion, maximum and reversal of sign, similar to those recorded by Nutting for solutions containing 28·6 % of the acid. These results are interpreted by means of the theory (which can be disproved experimentally in the case of the esters) that the lævorotatory β component is a polymer of the dextrorotatory α component. T. M. L.

2264. *The Rotatory Power of Tartaric Acid.* **E. Vellinger.** (Comptes Rendus, 184. pp. 1010–1012, April 25, 1927.)—The author has shown recently [see Abstract 971 (1927)], that the rotatory power of tartaric acid solutions approaches, as dilution increases, to a limiting value which is that of the tartrate, or, more exactly, that of the tartaric anion. The experimental principle of Longchambon's work [Abstract 972 (1927)] is criticised, and the author maintains his former statements. G. E. A.

2265. *Magnetic Rotation of Ferric Solutions.* **Constance E. Richards** and **R. W. Roberts.** (Phil. Mag. 3. pp. 770–784, April, 1927. Supplement.)—Detailed study of the magnetic rotary dispersion of solutions of certain ferric salts in water. A. D.

2266. *Determination of the Optical Anisotropy Coefficient of Air Molecules by Measurements of Sky Polarisation.* **I. I. Tichanowsky.** (Phys. Zeits. 28. pp. 252–260, April 1, 1927.)—The optical coefficient of the anisotropy of air molecules, *i.e.*, the ratio of that component of the perpendicularly scattered light which is polarised perpendicularly to the visual plane to the component polarised in the visual plane may be determined by measurements of sky polarisation. On Mount Ai-Petri, in the Crimea, simultaneous measurements of polarisation in the zenith with a solar altitude of 0° of the amount of floating matter and of the absolute humidity by means of extrapolation gave 856 per mille as the value of sky polarisation for an absolutely pure atmosphere. A generalisation of the Cabannes theory gives expressions for the intensities of the light scattered in any given direction through the unit of volume of a gas with anisotropic molecules, and also for the magnitude of the polarisation, the general intensity and the coefficient of extinction. From the consideration of the primary and secondary diffusion through the anisotropic gas molecules the expression is derived for the polarisation dispersed by the air near the earth's surface. The theory of sky polarisation thus formed gives a quantitative explanation of its dispersion and enables Loschmidt's figure to be calculated from the polarisation measurements, giving a value of $2{\cdot}52 \times 10^{19}$. From the aforesaid number 856 we get 0·046 for the optical coefficient of anisotropy of the air molecules, which agrees with laboratory measurements. The treatment of the problems is entirely mathematical. [See Abstracts 69 (1924) and 317 (1927).] E. F.

2267. *Limits of Classical Scattering.* **P. M. S. Blackett.** (Cambridge Phil. Soc., Proc. 23. pp. 698–702, April, 1927.)—If de Broglie's condition is satisfied that $Z = \frac{\cos\theta}{2\pi} \cdot \frac{1}{V} \cdot \frac{dV}{dl} \cdot \lambda << 1$, where V is the phase velocity, λ the wave-length, l the direction of greatest increase of V, and θ the angle between l and V, then the method of geometrical optics provides an approximate solution of wave propagation. If the condition is not satisfied, a rigorous solution of the wave equation is required to describe the phenomena, and this solution will correspond to a kind of diffraction effect. The condition is evaluated and applied to cases of scattering of particles. Reasons are given for the disagreement with the results of Rutherford and Chadwick's experiments. The type of scattering which will occur with particles of different velocities is also discussed, classical scattering occurring as the velocity approaches zero. R. S. R.

2268. *Polarisation of the Light Deflected by Mercury Particles in the Dark Field.* **U. Gerhardt.** (Phys. Zeits. 28. pp. 250–252, April 1, 1927.)—Continuing the experiments with the interferometer [see Abstract 981 (1926)], it was found that the polarisation phenomena observed when the Hg particles were immersed in air differed considerably from those obtained with oil immersion. (A) *Air Immersion.*—The particles being illuminated with natural light, analysis with the nicol showed that the terminations of the diameter parallel to the long diagonal were almost entirely quenched. Linearly polarised light gave the same result. It can be shown that polarisation of the light on the particles is on the one hand intensified and on the other weakened, seeing that with the crossed analyser the luminous ring of the image is not entirely quenched, but that the terminations of the diameter parallel to the direction of oscillation of the electric illuminating vector are darker than those perpendicular to it, whilst in the intermediate directions the annular zones still show a somewhat reduced luminosity. (B) *Oil Immersion.*—Natural light shows a distortion of the images, the luminous margin appearing in the analyser as an ellipse, its major axis coinciding with the direction in which the electric vector passes through the analyser. Within the limits of error, the magnitude of this elliptical distortion is the same for all particles. It is seen very clearly if a Wollaston be used as analyser, its two images showing the distortion at right angles to each other. Experiments were also made with immersion in water and a mixture of alcohol and water. The same results were observed but, speaking generally, not so well marked as with oil. In the luminous field the Hg particles showed the same elliptical distortion whether in air or oil. On illuminating them with linearly polarised light, analysed at the eyepiece, the crossed analyser did not reveal a uniformly dark field of vision but showed the particles clearly standing out and having a dark cross in the direction of the two diagonals, the intermediate margin being faintly illuminated. E. F.

2269. *Intensities in Interference of Light.* **E. Schult.** (Ann. d. Physik, 82. 8. pp. 1025–1050, May 12, 1927.)—As between the pure wave-theory and the quantum theory, data have been lacking in respect of the intensities in an interference field. The author finds that the intensities from maximum to minimum are in good accord with the pure wave-theory; and so are the minimum intensities. The stationary wave effects were well observed. A. D.

2270. *White-Light Interference Fringes with a Thick Glass Plate in One Path. Part II.* **W. N. Birchby.** (Nat. Acad. Sci., Proc. 13. pp. 216–221, April, 1927.)—Continuing the discussion of the results of experiments described in Part I [see Abstract 823 (1925)], a fundamental equation is derived expressing the phase-difference on re-uniting the two beams into which an oblique beam is split by the interferometer, in terms of the wave-length, the angle made with the optical axis and other factors. The character and applications of the equation are discussed. A. B. C. L.

2271. *Photographic Reversion.* **V. P. Lubovich.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 309–311, April, 1927.)—The reversion of the image by long exposure was illustrated by two photographs of the mercury spectrum, one being exposed for 9 hours using a Wratten filter, the other without a screen and exposed for 20 minutes. The line with the wave-length 4359 Å. was completely reversed. A similar reversion was obtained when photographing the eclipse of the sun on January 24, 1925. The reversion reached a maximum at the seventh exposure. The exposures were of two minutes' duration. When the density of an image, defined as log I_0/I, that is, intensity of light incident on the plate/intensity of transmitted light, is plotted against the image number, the curve suggests that the reversion due to over-exposure is analogous to a damped vibration. F. J. B.

2272. *Light-Sensitiveness of Zinc and Silver Salts.* **F. G. Brickwedde.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 312–322, April, 1927.)—Lithopone is a mixture of barium sulphate and zinc sulphide, and darkens when exposed to ultra-violet light. The light-sensitivity curves of the photochemical changes in lithopone and silver chloride were determined. It was found that the sensitivities of the two substances did not increase regularly with decreasing wave-length of the light. The time required for the darkening of lithopone to the same degree varies inversely as the intensity of the light. Different samples of lithopone showed the same ratio of sensitivities for all wave-lengths. Evidence in favour of the view that the darkening was the result of the liberation of metallic zinc and hydrogen sulphide was obtained. The sensitivity decreased rapidly as the temperature rose from 0° to 16° C. and then increased slightly from 16° to 40° C. The therapeutic values of several arcs were determined and the highest value was obtained for the quartz-mercury arc, which was 6·8 times the value of the Pfund iron arc. The carbon arc had only 0·05 the value of the Pfund arc. F. J. B.

2273. *The Relation between the Specular and the Diffuse Photographic Densities.* **L. Silberstein** and **C. Tuttle.** (Eastman Kodak Co. Research Lab. Comm. No. 297. Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 365–373, May, 1927.)—Previous work [see Abstract 2832 (1926)] on this relation has been purely experimental, and in the present investigation a formula is derived correlating the two densities from general theoretical considerations, *viz.*, $10^{-D} = \epsilon \cdot 10^{-D'} + (1 - \epsilon) \cdot 10^{-\beta D'}$, where D and D′ are the specular and diffuse densities respectively, ϵ is the fraction of the total scattered flux contained in the normally or quasi-normally emerging beam, and β is a constant > 1 and equal to $1 + A/kw$, where A is the wave-length, w the average effective area of a grain, and k a numerical factor. Experimental confirmation is included. H. H. Ho.

2274. *Quantitative Investigations on the Excitation of Phosphorescence by Slow Kathode Rays.* **H. W. Ernst.** (Ann. d. Physik, 82. 8. pp. 1051–1076, May 12, 1927.)—Kathode rays were produced from a tungsten filament connected to a high-tension generator. The phosphor was placed on a platinum foil which could be electrically heated. The density of the electron stream was measured by connecting the Pt foil through a galvanometer to earth. Phosphors were chosen giving blue and green bands so that a photoelectric cell could be used for the light measurement. The specific distribution was measured with a spectrophotometer and was found to be quite different with kathode rays and with light excitation. The intensity of all bands is strictly proportional to the electron stream density. The relation between the velocity of the electrons and the light intensity per unit current gives a sigmoid curve. The efficiency coefficient is much lower than Lenard's [Abstract 2958 (1904)] and is the same for different preparations, intensities and voltages, but is dependent on the concentration of activation metal. Other results are given in the previous paper. J. E.

2275. *The Fluorescence Yield from Dyestuff Solutions as a Function of the Wave-Length of the Exciting Light. Part II.* **S. J. Wawilow.** (Zeits. f. Physik, 42. 4. pp. 311–318, 1927.)—This paper continues previous work [see Abstract 1874 (1922)], confirmed by Valentiner and Rössiger [see Abstract 1868 (1925)], and measurements are now recorded for the fluorescence yield from fluorescein solutions within the absorption range 250–540 $m\mu$. From 250 to 430 $m\mu$ the yield is proportional to the wave-length, onwards to the wave-length corresponding to the maximum of the fluorescence spectrum it is essentially constant, later decline rapidly occurs. For æsculin solutions the fluorescence is independent of the wave-length within the interval 250 to 405 $m\mu$. The results are in analogy with some photo-chemical considerations of Franck. H. H. Ho.

2276. *Luminescence of Quinine Sulphate.* **A. Petrikaln.** (Zeits. f. Physik, 42. 5–6. pp. 435–442, 1927.)—The apparatus is described for studying the light given out by the reversible water absorption of quinine sulphate. The luminescence spectrum was photographed and analysed. It consists of two wide bands on whose background nine small bands (20–30 Å. wide) can be distinguished between 4330 and 3580. These small bands can be arranged in series and a term level scheme developed. The idea is supported that the light is related to the giving up of water. Finally, energy relations are discussed. J. E.

2277. *Glow of Arsenic.* **H. J. Emeléus.** (Chem. Soc., J. pp. 783–788, April, 1927.)—According to Joubert (Comptes Rendus, 78. p. 1853, 1874), a certain minimum oxygen pressure is necessary for the appearance of the glow of arsenic. Experiment shows that the formation of arsenic trioxide begins well below 200° C., and between 250° C. and 310° C. the rate of oxidation increases slightly as the pressure is decreased, the reaction being non-luminous. At a certain critical pressure, the "glow pressure," the ratio of oxidation suddenly increases and a glow appears near the arsenic surface, the temperature rising simultaneously by about 7° C. The presence of aqueous vapour permanently retards the reaction, probably owing to the formation of non-volatile films on the arsenic grains. The glow pressure depends both on the temperature and on the length of the heated tube.

When the arsenic is heated in a current of air or oxygen, the temperature at which the glow appears increases with the length of tube heated, varying from 210° to 290° C.; the temperatures are lower than in stationary gas at the same pressure. In oxygen the glow occurs at a temperature higher by about 10° than in air under identical conditions. No effect is produced on the glow temperature by saturating the air at room temperatures with carbon tetrachloride or nitrobenzene or by diluting it with 10 % by volume of sulphur dioxide, although all these substances inhibit the glow of phosphorus. Apparently the arsenic oxide formed hinders the reaction, this effect becoming smaller as the concentration gradient determining the removal of the oxide by diffusion becomes steeper. The effect of reduction of pressure in promoting the glow may similarly be due to an acceleration of the removal of oxide. T. H. P.

2278. *Origin of the Ultra-Violet Spectrum of the Glow of Phosphorus.* **H. J. Emeléus** and **R. H. Purcell.** (Chem. Soc., J. pp. 788–793, April, 1927.)—Photographs of the ultra-violet spectrum of the phosphorescence of phosphorus pentoxide exhibit none of the bands occurring in the spectrum of the glow of phosphorus. The discharge through the vapour of phosphorus pentoxide in a silica tube gives a complex band spectrum, which includes all the bands known in the spectrum of the glow of phosphorus, and re-examination of the latter reveals further bands common to these two spectra. It is concluded that the ultra-violet spectrum of the glow of phosphorus has its origin in the molecule of an oxide. T. H. P.

V. 19

2279. *Quantum Mechanics of Directed Degeneration.* **J. R. Oppenheimer.** (Zeits. f. Physik, 43. 1–2. pp. 27–46, 1927.)—In this mathematical paper it is shown that the disturbance of degenerate systems may be investigated in quantum mechanics without auxiliary fields. The spontaneous radiation of such disturbed systems has been calculated on the Dirac theory. As special cases the Heisenberg polarisation rule is found for the resonance illumination, the Skinner rule for the impact illumination, and the Hanle rule for the influence of external fields. The theory is applied to various problems of impact illumination and the anomalous polarisation of the mercury resonance line is interpreted as a resonance effect. H. H. Ho.

2280. *Numbers of Dispersing Electrons for Continuous Spectra and for Hydrogen Lines.* **Y. Sugiura.** (J. de Physique et le Radium, 8. pp. 113–124, March, 1927.)—Schrödinger and Pauli [Abstract 2537 (1926)] have calculated the relative intensities of the Lyman and Balmer series lines using new mechanics. The author in this paper uses similar methods to calculate the numbers of dispersing electrons not only for the hydrogen series, but also for continuous spectra. The duration of emission for states N, where N is 1, 2, 3, or 4 is also calculated. A. C. M.

2281. *Flash Arc Spectrum of Cæsium.* **F. H. Newman.** (Phil. Mag. 3. pp. 843–848, April, 1927. Supplement.)—An account of the spectrum observed when an intermittent arc discharge is passed between electrodes of cæsium *in vacuo*. The spark lines are much more intense than the arc lines; they are divisible into two groups, which are considered to be analogous to the red and blue spectra of xenon. A. C. M.

2282. *Electrodeless Discharge. Continuous Spectra of Cæsium and Potassium.* **G. Balasse.** (Comptes Rendus, 184. pp. 1002–1005, April 25, 1927.)—Research on the high-voltage electrodeless discharge with damped waves shows that for cæsium vapour at about 150° the spectrum comprises the spark lines, the arc lines being only feebly represented. As the temperature is raised the spark spectrum gives place progressively to the arc spectrum. At the same time, above 200°, a continuous spectrum appears, located in the part of the discharge tube which is most weakly excited. This spectrum at first increases in intensity as the arc spectrum grows stronger. It extends through all the visible spectrum and beyond the limit of the principal series of the arc spectrum. It is concluded that the continuous spectrum is produced by recombination of the singly ionised cæsium atom with an external electron of variable kinetic energy. Spectrograms at increasing temperatures and for discharge voltages up to 40,000 volts show (1) that the continuous spectrum reaches maximum intensity for conditions of excitation such that the arc and spark spectra exist simultaneously with approximately the same intensity, and (2) that it does not appear if either the spark spectrum alone is given or the spark spectrum has given place to the arc spectrum. Spectrograms obtained under similar conditions with potassium vapour show that it also gives an analogous continuous spectrum. Esclangon has observed a continuous spectrum of cadmium which appears to be of the same nature as those found for cæsium and potassium [Abstract 1347 (1926)]. Using the electrodeless discharge with undamped waves, stable luminous discharges were obtained for Hg, HCl, I, Cs and K. For Hg, Cs and K the spectrograms only contained arc lines of great intensity. For Cs and K the continuous spectrum never appeared, which fact is in agreement with the hypothesis put forward for the origin of this spectrum. A. W.

2283. *Continuous Spectra in the Electrodeless Discharge in Mercury Vapour.* **G. Balasse.** (Comptes Rendus, 184. pp. 1320–1322, May 30, 1927.)—The author's experiments with the vapours of potassium and of cæsium [see preceding Abstract], and also Esclangon's work on cadmium vapour, have led to the hypothesis that the continuous spectrum in the luminescence of these substances produced by the electrodeless discharge is the criterion of the passage from a given degree of ionisation to that immediately inferior. His present experiments with mercury vapour show that also with this substance the above hypothesis is justified. Two continuous spectra were obtained, and either could be produced at will. For the isolation of the two, however, the discharge tube temperature must be maintained very constant. If this is not the case during the time taken to obtain a spectrogram, the two continuous spectra are superposed. A. W.

2284. *Continuous Spectra. Part IV.* **A. Wintner.** (Ann. d. Physik, 82. 3. pp. 346–354, Feb. 8, 1927.)—A continuation of the work in Abstract 304 (1927). Matrix mechanics applied to continuous spectra. A. C. M.

2285. *Polarisation of the Resonance Radiation of Mercury Vapour and the Influence of Magnetic Fields and Gases.* **V. v. Keussler.** (Ann. d. Physik, 82. 6. pp. 793–835, April 4, 1927.)—By means of a simple photoelectric apparatus which enables exact measurements in the ultra-violet, the author has investigated polarised resonance radiation of mercury vapour for the line 2536·7. [See Wood and Ellett, Abstract 99 (1925).] Weak magnetic fields produce the effects deduced on the classical electronic theory. The strength of the polarisation is dependent to a high degree on the mercury vapour pressure, and for its explanation an effective atomic radius fifty times greater than that given on the kinetic theory must be assumed. Extrapolated to zero vapour pressure, the degree of polarisation amounted to 80 %, and, by a suitably orientated magnetic field, this was raised to 100 %. When other gases were introduced (H_2, O_2, N_2, CO_2, CO, and the helium series) the depolarisation produced corresponded to larger atomic radii in some cases, and to normal radii in others as calculated from the kinetic theory. For instance, hydrogen gave the strongest effect corresponding to an atomic radius four times that usually accepted.
H. H. Ho.

2286. *New Infra-Red Absorption Bands of Methane.* **J. W. Ellis.** (Nat. Acad. Sci., Proc. 13. pp. 202–207, April, 1927.)—In order to observe absorption maxima, due possibly to overtones and combination bands in the range of the visible spectrum up to 2·8 μ, the author fits the self-registering spectrograph of his [see Abstract 713 (1926)] with a long cell, a thick-walled vulcanised fibre tube, 87·5 cm. long, 3·7 cm. inside diameter, and uses a tungsten lamp beam. Bubbling the methane through sulphuric acid (strong or fuming), he observes five new bands: 1·15, 1·37 (1·66, 1·72), 1·80; the two in parentheses may be the partly resolved first harmonic of the band 3·33 of Cooley [see Abstract 306 (1926)], and 1·15 the second harmonic. He discusses the bands with respect to Cooley, Dennison [see Abstract 307 (1926)] and also Schaefer and Philipps [see Abstract

2387 (1926)], who discovered difference combinations in the CO_2 spectrum. The bands mentioned, and further 1·32, 3·33 and 7·67 μ, indicate that the methane molecule as a whole takes part in the absorption. The same bands are observed in the higher (liquid) paraffins, to which only the C–H linkage is common; these bands must therefore be associated with that atomic pair. But the author modifies his own view [see Abstract 1582 (1926)] as to the parabolic series. H. B.

2287. *Relativity Fine-Structure of Helium.* **F. Paschen.** (Ann. d. Physik, 82. 5. pp. 689–696, March 22, 1927.)—Photometric investigation of the spectrum of helium excited by direct current shows that the He^+ line 4686 absolute wave-length corresponds exactly with the theoretical value. Also the separation of the components leads to the exactly correct value $\Delta\nu_H = 0\cdot365$ cm.$^{-1}$. Thus the conclusions of Leo (who ascribed a component to helium bands) are unfounded. A. C. M.

2288. *Bands in the Extreme Ultra-Violet Spectrum of a Helium Discharge.* **L. A. Sommer.** (Nat. Acad. Sci., Proc. 13. pp. 213–216, April, 1927.)—Scrutiny of photographs taken and discussed by Lyman [see Abstract 2975 (1924)] in He with a vacuum spectrograph leads to the suggestion, in respect of the persistent "line" at λ600·3 ± 0·6, that the latter may have reference to the radiation of the He molecule, or that a fundamental state may exist in the He molecule spectrum corresponding to the fundamental state ^1S(= 198,298 cm.$^{-1}$) of the atom. In an attempt to compute the position of a band $1^1S - 2^1S$ and extrapolate for this purpose from the (effective) quantum number $n^* = 1\cdot853$ of the 2^1S term in the molecule in analogy to the course of the corresponding quantum numbers (1·850, 0·744) in the atom to the value $n^* = 0\cdot744$ for the 1^1S term in the molecule, support is found for the view that the "line" cannot be a transition between atomic levels $1^1S - 2^1S$ caused by the presence of the electric field. The evidence indicates rather that the He radiation at λ600·3 ± 0·6 is in reality a band. The appearance of other weaker bands is noted.

A. B. C. L.

2289. *Infra-Red Absorption Spectra of Acetylene, Ethylene and Ethane.* **C. F. Meyer** and **A. A. Levin.** (Nat. Acad. Sci., Proc. 13. pp. 298–302, May, 1927.)—A preliminary note on investigations of the region between 3 μ and 15 μ. All three spectra reveal fine structure of the bands of these compounds, which each contain two atoms of carbon. There are regularities of a type not previously observed in vibrational-rotational bands. The absorption region of greatest wave-length for each gas is investigated as probably representing one of the fundamental frequencies of vibration. For ethylene this region lies at a shorter wave-length than for the other gases and is most accessible to measurement. In this case an intense central maximum occurs at 10·53 μ. In the case of ethane the curve shows a succession of regular type of maxima, both as regards intensity and spacing. The curve is irregular between 11·9 μ and 11·6 μ. The acetylene curve shows an intense central maximum or "Q" branch. The curves are compared with and show agreement with the Coblentz data. S. G. B.

2290. *Spectra of Boron.* **R. A. Sawyer** and **F. R. Smith.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 287–303, April, 1927.)—An application of a modified form of vacuum spark apparatus [see Abstract

2177 (1923)] to find boron lines in the blue and ultra-violet. The chief modification is the use of glass instead of metal, giving less trouble with insulation. About a hundred new boron lines have been found, and about twenty have been classified. A. C. M.

2291. *Series Spectra of Ionised Phosphorus, P_{II}.* **I. S. Bowen.** (Phys. Rev. 29. pp. 510–512, April, 1927.)—One hundred and ten of the strong lines of P_{II} have been classified as arising from various combinations between thirty-two terms of the triplet system. The observed terms are exactly those demanded by the Hund theory. AUTHOR.

2292. *New Measurements on the Second Order Normals in the Arc Spectrum of Iron from $\lambda = 5167$ to $\lambda = 6678$ Å.* **W. Kleinewefers.** (Zeits. f. Physik, 42. 2–3. pp. 211–221, 1927.)—A continuation of Wallerath's work. [See Abstract 2957 (1924).] The secondary normals have been measured with an interferometer. A table of results is given. J. E.

2293. *Spark Spectrum of Lead.* **H. Gieseler.** (Zeits. f. Physik, 42. 4. pp. 265–275, 1927. From the Reichsanstalt.)—The lines of the spark spectrum of lead are here investigated by means of a Schüler lamp. It enables a doublet spectrum to be analysed of which the limit is the ^{1}S-term of PbIII. The arrangement of the outer electrons is 1 ; 1 ; *k*. The lowest term of the spectrum corresponds to a ^{2}P term with the splitting 14,066 cm.$^{-1}$. The distance of both limits in PbI is also given by it. It is striking that the 2D and 2F terms of these spectra are inverted. It also gives in PbII spectrum some anomalous terms, order of magnitude 50,000 to 60,000 volts, to which a spectrum with the limit ^{3}P belongs—arrangement of the outer electrons 1 ; 2 ; *k*. A. E. G.

2294. *Intensity of Spectral Lines.* **A. E. Brodsky.** (Zeits. f. Physik, 42. 11–12. pp. 899–904, 1927.)—Combination of thermodynamical with statistical equilibrium conditions and with the radiation of excited atoms has led to a formula for the intensities of the spectral lines of a series. This formula has been well established by experimental results for rubidium and cæsium. The assumption of a purely temperature excitation as the main cause of emission has been confirmed. The temperature dependence of the intensities follows from the fundamental formula. H. H. Ho.

2295. *Swan-Band of Carbon.* **R. C. Johnson.** (Roy. Soc., Phil. Trans. 226. pp. 157–230, Jan. 25, 1927.)—The origin of this spectrum has been one of the long-standing controversies of spectroscopy. A carbon molecule and a hydrocarbon molecule have been the two most favoured sources. The sources employed were: (*a*) carbon-arc in hydrogen (1–10 mm.), (*b*) vacuum tubes containing traces of carbon gases and filled with 20–50 mm. of an inert gas. A survey of the spectrum was made in the second-order of a 21-ft. grating, and the wave-lengths of about 2000 lines are recorded. Series were then assigned to eleven bands. The rotational energy functions were evaluated, and the method is described with details of the graphical determination of moments of inertia. From the second components of the triplets for the λ5165 head we have $I' = 16 \cdot 236 \times 10^{-40}$, and $I'' = 17 \cdot 410 \times 10^{-40}$, giving for intranuclear distances before and after the transition $1 \cdot 230 \times 10^{-8}$ cm. and $1 \cdot 274 \times 10^{-8}$ cm. These

are appropriate to a HC–CH molecule. The data of several bands are considered, and alternative explanations of the band structure are reviewed. It is finally decided that the bands consist of a P and R branch typical of a dipole emitter. The bands exhibit several anomalous features which are discussed. The fine-structure multiplicity classes the bands as of Heurlinger triplet type. The distribution of energy among the vibrational states suggests that the Swan bands are a high-temperature system, but probably a non-thermal one. In addition a new band system associated with the Swan bands is recorded. The evidence of experiment and analysis is declared to be conclusive in favour of a HC–CH molecule.
A. C. M.

2296. *Structure of the LaII Spectrum.* **W. F. Meggers.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 191–204, March, 1927.)—Allocations are based on Zeeman-effect observations, temperature class observations, and constant-frequency differences, guided by the Heisenberg-Hund theory. In addition to 20 levels found by Goudsmit, 22 more have been found, and the combinations of these 42 levels give rise to about 180 lines. Singlet S, P, D, F, G terms and triplet P, D, F, G terms have been found. Deviations from the interval rule and Zeeman-effect rules occur, and there is a serious violation of the rules governing *raies ultimes*.
A. C. M.

2297. *A Method of Investigating a Substance in Layers.* **K. Becker.** (Zeits. f. Physik, 42. 2–3. pp. 222–225, 1927.)—By etching a tungsten wire in layers and investigating by the Debye-Scherrer method differences in the outer and inner zones have been discovered.
J. E.

2298. *Compton Effect.* **E. Schrödinger.** (Ann. d. Physik, 82. 2. pp. 257–264, Jan. 12, 1927.)—The problem is to explain, on the basis of simple phase considerations of the de Broglie waves, the variations in the direction and frequency of the ether waves in the Compton effect. The corresponding problem of the intensity would require a detailed investigation such as has been done by Gordon. [See Abstract 1417 (1927).] With the relativistic ψ-wave equation

$$\Delta\psi - \frac{1}{C^2}\psi - \frac{4\pi^2\nu_0^2}{C^2}\psi = 0 \;\ldots\ldots \quad (1)$$

is associated a moving electron whose four-vector energy impulse is $\frac{h\nu}{C}$,

$$\frac{h\sqrt{\nu^2-\nu_0^2}}{C}\cdot\alpha, \qquad \frac{h\sqrt{\nu^2-\nu_0^2}}{C}\cdot\beta, \qquad \frac{h\sqrt{\nu^2-\nu_0^2}}{C}\cdot\gamma,$$

where (α, β, γ) are the direction cosines of the moving electron. From the wave point of view this is called the four-vector extension (*Ausbreitung*) and is a purely kinematical concept. If we superpose two waves of the type (1) we get a density wave whose extension is given by $D = A - A'$, where A and A′ are the extensions of the two ψ-waves. A theorem analogous to Brillouin's theorem on the reflection of a light wave by a sound wave is applied, after reducing the density wave to rest by a Lorentz transformation; then the direction and frequency laws of the Compton effect are derived.
A. C. M.

2299. *X-Ray Information of Grain Growth and "Vergütung" in Tungsten Wire by Means of Debye-Scherrer Diagrams.* **K. Becker.** (Zeits. f. Physik, 42. 2–3. pp. 226–245, 1927.)—The appearance of Debye-Scherrer lines under various conditions and the bearing on grain size and distortion of the lattice is discussed. It is explained with diagrams and tables how the failure of the so-called Arkel resolution for a doublet can be used to indicate distortion of the lattice down to 0·05 %. These ideas are then used in an experimental investigation of tungsten wire. The results show that strengthening of the wire corresponds to a return to the normal lattice. The "Vergütung" temperature and the recrystallisation threshold are also determined by the same method. It is shown how the alteration of the electrical conductivity measured by Geiss and v. Liempt [see Abstract 2437 (1926)] can be explained by lattice distortion. J. E.

2300. *Electron Velocities at the Compton Effect.* **P. Lukirsky.** (Zeits. f. Physik, 42. 7. pp. 516–531, 1927.)—In this investigation the velocities of the Compton electrons have been experimentally determined by irradiation of graphite with almost monochromatic Röntgen rays over the spectral range of 3 to 6 Å. The number and velocities of the Compton electrons were found for three different directions, *viz.*, at angles of 0°, 15°, and 40° with the incident beam. The asymmetry of the Compton effect enables the Compton electrons to be observed separately from the photoelectrons. The dependence of the electron velocities on the wave-length of the incident beam and on the direction of the electrons concerned is found to be in accord with the requirements of the Debye-Compton theory. The observed velocities are in good agreement with those calculated, when consideration is taken of the contact work performed by the electrons. This shows that in such cases the free, or almost free, electrons which condition the conductivity of the graphite produce the Compton effect. The number of Compton electrons under these experimental conditions amounts to approximately 10 % of the photoelectrons. H. H. Ho.

2301. *Dependence of X-Ray Wave-Lengths on Combination.* **T. Wetterblad.** (Zeits. f. Physik, 42. 8. pp. 603–610, 1927.)—The wave-lengths have been measured of the Kβ_1 lines of Na, Mg, and Al in the metallic form and also as oxides. Shifts are found, presumably due to the oxygen. Also shifts are found for compounds of sodium with the halogens. The shifts on oxidation are for Na, Mg, and Al 42 X.U., 39 X.U., and 21 X.U. respectively. The shifts comparing NaF, NaCl, NaBr, and NaI with Na are in X.U. 85, 81, 69, and 62 respectively.

A. C. M.

2302. *X-Ray Intensity and Current Strength.* **D. Nasledow** and **P. Scharawsky.** (Zeits. f. Physik, 42. 11–12. pp. 870–882, 1927.)—Continues the work of a previous paper [see Abstract 1768 (1927)]. The same relation as was found for Cu rays holds for Mo, K$_\alpha$ and K$_\beta$, Pd, K$_\alpha$ and K$_\beta$, and for AgK$_\alpha$ rays, but the first linear relation between current strength and X-ray intensity continues up to 6 mA. W. H. Ge.

2303. *Dispersion and Scattering of X-Rays.* **H. Kallmann** and **H. Mark.** (Ann. d. Physik, 82. 5. pp. 585–604, March 22, 1927.)—On the assumption of a continuous succession of resonances in the region of the X-ray absorption spectrum a calculation is made of the electric moment of an atom-electron under the influence of incident radiation, making use of the theoretical quantum dispersion law. The constant of the absorption law found empirically is now shown to agree with the theoretical deductions. A formula for the scattering of X-rays in gases, amorphous bodies and crystals is discussed. The anomalous dispersion of crystals in the neighbourhood of the critical region is calculated and shown to be in qualitative agreement with experience. A. B. W.

2304. *Methods of Examination of Real and "Culture" Pearls.* **J. Galibourg** and **F. Ryziger.** (Rev. d'Optique, 6. pp. 97–133, March, 1927.)—The paper gives practical data for distinguishing between real or spontaneous pearls and "culture" pearls. The "culture" pearl contains a spherical nucleus of "nacre" mother-of-pearl several mm. in diameter, which can be identified by five different properties: (1) *Density.*—The "nacre" is generally more dense than the pearl. (2) *Structure.*—It is necessary in this case to cut the pearl. (3) *Transparency to Luminous Rays.*—After immersion in a liquid of known index of refraction, and at a suitable orientation, the cultivated pearl contains a non-homogeneous nucleus, which is evident from the different opacity of the various layers of "nacre." (4) *Interference of X-Rays.*—The two types of pearl give different X-ray spectra. (5) *Propagation of Light in the Body of the Pearl.*—The propagation is spherical in the layers of pearl, rectilinear in the planes of "nacre." A combination of two or more of the above methods is considered certain to determine the character of any pearl. [See also Abstract 1410 (1927).] A. B. W.

2305. *Influence of Physical and Chemical Constitution of Resistance Cells on the Intensity of the Radiation which they Emit.* **G. Reboul, G. Déchène** and **R. Jacquesson.** (J. de Physique et le Radium, 8. pp. 199–214, April, 1927.)—Describes an investigation of the effect of the constitution of the resistance coil on the type of radiation emitted. In the first section the physical conditions are studied—variation as a function of time, fatigue of cells, influence of applied voltage, pre-history of the substances employed, action of humidity, etc. In the second section the influence of chemical constitution of the cell is considered. The cells employed are those of the alkali metals or alkaline earths. In the third section theoretical formulæ are given showing the variation of current in the cells as a function of time, potential drop at the electrodes, and the variations of intensity of the radiation emitted. A. B. W.

RADIOACTIVITY.

2306. *Anomalous Scattering of α-Rays.* **W. Hardmeier.** (Phys. Zeits. 28. pp. 181–195, March 1, 1927.)—In a theoretical paper the author discusses the effect of the polarising power of the atomic nucleus on the scattering of α-particles. A short abstract is not possible. A. B. W.

2307. *The Scattering of the Lengths of Range from Wilson Photographs.* **M. v. Laue** and **L. Meitner.** (Zeits. f. Physik, 41. 6–7. pp. 397–406, 1927.)—It is shown that the differences in the lengths of the tracks of α-rays observed in the Wilson cloud chamber have no direct theoretical meaning, since they are influenced by the alterations in the density of the gas during the expansion. An attempt is made to get rid of the disturbing influence of these alterations by means of calculations in the cases of argon and nitrogen. The mean range of the α-rays of ThC + C′ in water-saturated argon under normal conditions is found to be 9·302 cm. and the coefficient of scattering $\rho = 0{\cdot}013$, Bohr's value being 0·0119, the difference lying within the limits of experimental error. The value obtained by Meitner and Freitag was 0·0121 [see Abstract 153 (1927)], so that the present more accurate correction for density fluctuations makes little difference. For nitrogen $R_0 = 8{\cdot}66$ cm. $\rho = 0{\cdot}0160$. This value of ρ is distinctly larger than that of Bohr, and the difference is still greater for oxygen. Reasons are given for supposing that this is due to a film of water deposited on the active preparation in these gases, which does not form in argon for electrical causes due to the differences in the affinity of the different gases for electrons. H. N. A.

2308. *Effect of Orbital Velocity of Electrons in Heavy Atoms on the Stopping of α-Particles.* **L. H. Thomas.** (Cambridge Phil. Soc., Proc. 23. pp. 713–716, April, 1927.)—The paper contains the result of calculations on the stopping powers of neon, argon, krypton and xenon. The electrons are supposed to be moving in orbits, as calculated by Hartree [Cambridge Phil. Soc., Proc. 21. p. 625, 1923] to fit X-ray and optical data for sodium, potassium, rubidium and cæsium. Following Henderson [see Abstract 190 (1923)], the electrons are treated as free and collisions are ignored unless the transfer of energy is sufficient to remove the electrons from the atom, but the speed of the electron in its orbit is taken into account. The stopping powers, etc., calculated are compared with Gurney's experimental values [see Abstract 1681 (1925)], with which they are in fair agreement. A. B. W.

2309. *The Stopping Power of Hydrogen Atoms for α-Particles according to the New Quantum Theory.* **J. A. Gaunt.** (Cambridge Phil. Soc., Proc. 23. pp. 732–754, April, 1927.)—Deals with the less close collisions, and represents the α-particle as a point moving with constant velocity in a straight line, and forming the centre of a Coulomb field. The effect on the atom, which is supposed fixed, can be found by the perturbation theory, which must be carried to the second order, since the first order gives a zero result. The new quantum theory deals in statistical averages, and gives a mean energy transfer without regard to individual jumps, so that if there is surplus energy it is not wasted, as in Henderson's theory, which is based on the old quantum theory. Adding to the rate of loss of energy thus calculated that obtained by the earlier theories for the close collisions, a formula is obtained of the same form as that of Bohr, with a slight modification of the constants. This formula holds for monatomic hydrogen, for which there are no experimental data. As on the classical theory, there is an average transfer of energy from the α-particle to atoms at all distances, and this is of nearly the classical amount. H. N. A.

2310. *Disintegration of Elements by α-Rays.* **G. Kirsch** and **H. Pettersson.** (Zeits. f. Physik, 42. 9–10. pp. 641–678, 1927.)—Discusses the differences between the results obtained in Vienna and at Cambridge. These appear to be due to differences in the experimental methods employed, and particularly to the design of the observing microscopes. Those used in recent work at Vienna are much more suitable for detecting the faint scintillations due to slow H-particles than those employed in

Cambridge; and at the former place much greater attention has been paid to the background on which the scintillations are observed. Unless special precautions are taken this is lighted up by the impact of γ-rays from the α-ray source, and the fainter scintillations cannot be observed. The use of the slow α-rays from polonium, which does not send out γ-rays, gets over this difficulty, which does not arise with the retrograde method. Independent methods are mentioned, including that of Holoubek, who used the Wilson cloud method in such a way that the α-particle tracks were excluded, and only the H-particle tracks observed and photographed. These confirm the results obtained by the authors using the scintillation method. H. N. A.

2311. *Disintegration of the Carbon Atom.* **H. Pettersson.** (Zeits. f. Physik, 42. 9–10. pp. 679–703, 1927.)—Investigations by scintillation methods, extending over three years, are described. In these investigations the "disintegrability" of carbon in its purest obtainable form is determined. Researches of a similar character, by independent methods (photographic and the Wilson cloud method), are also mentioned, and it is confirmed that the carbon atom on bombardment by α-particles emits hydrogen particles. This result is in direct opposition to the results obtained by the Rutherford school at Cambridge. A. B. W.

2312. *Cloud-Tracks of Disintegrating Atoms.* **R. Holoubek.** (Zeits. f. Physik, 42. 9–10. pp. 704–720, 1927.)—The Wilson expansion chamber method is applied to the problem which relates to the disintegration of atomic nuclei by α-particle bombardment. The H-particle tracks are observed visually and photographically. A polonium source of α-particles is used to bombard various materials, Al paraffin wax, Be, C (diamond and graphite). In all cases H-particle tracks were observed, the numbers from Al and C being in the ratio 2 : 1. A. B. W.

2313. *Disintegration of Aluminium by α-Particles.* **E. A. W. Schmidt.** (Zeits. f. Physik, 42. 9–10. pp. 721–740, 1927.)—Gives a full account of the author's measurements using the scintillation method, which have been described in a previous publication [see Abstract 1596 (1926)]. The discrepancies between the results and those of Rutherford and Chadwick are discussed. The observations made, using independent methods, by Stetter and by Holoubek confirm the author's results. H. N. A.

2314. *Mass Determination of Atomic Fragments from Al, C, B and Fe.* **G. Stetter.** (Zeits. f. Physik, 42. 9–10. pp. 741–758, 1927.)—Using a mass spectroscope previously described [see Abstract 314 (1926)] the author has determined the masses of the secondary particles emitted from Al, C, B and Fe, as well as the α^{++}, α^{+} and H-particles set free at the same time. The results confirm those obtained by the Viennese school of workers, using other methods of observation. A. B. W.

2315. *Photographic Action of β-Rays.* **C. D. Ellis** and **W. A. Wooster.** (Roy. Soc., Proc. 114. pp. 266–276, March 1, 1927.)—The blackening of Ilford X-ray plates has been investigated under varying conditions, and it has been found that (1) the reciprocity law holds, (2) the form of the characteristic curve is independent of the velocity of the particle, and (3) the characteristic curve, as in the case of X-rays, follows the equation

$D = C \log (It/r + 1)$, giving an initial part which may be considered linear up to a density of 0·3. A. B. W.

2316. *The Absolute Intensities of the γ-Rays of Radium B and Radium C.* **C. D. Ellis** and **W. A. Wooster.** (Cambridge Phil. Soc., Proc. 23. pp. 717–729, April, 1927.)—The heating effect of the γ-rays, the total number of quanta emitted and the intensities of the groups of β-rays are correlated on the assumption that the values experimentally obtained depend on the value and rate of variation with frequency of the internal conversion coefficient of the γ-rays, and that when these have been determined the original intensities of the γ-rays can be calculated from the intensities of the β-ray groups. The internal conversion coefficient α for a frequency corresponding to V volts is assumed to be equal to $gf(V)$, and values of g are deduced from the number of γ-rays emitted by RaB and RaC, from the number emitted by RaC, and from the energy of the γ-rays emitted by RaB and C, assuming in turn that $f(V)$ equals $V^{-2 \cdot 5}$, $V^{-2 \cdot 6}$, $V^{-2 \cdot 65}$, $V^{-2 \cdot 7}$ and $V^{-2 \cdot 75}$. The values should be equal to one another, and this is nearly the case for $f(V)$ between $V^{-2 \cdot 6}$ and $V^{-2 \cdot 68}$. The experimental ratio, 0·11, between the energies of the γ-rays of RaB and RaC indicates that the higher power of the frequency is more nearly correct, and the authors adopt the value 2·65, the internal conversion coefficient having the value 0·12 at a frequency of $3 \cdot 54 \times 10^5$ volts, that of the strongest RaB γ-ray. A table gives preliminary estimates of the intensities of the γ-rays of RaB and RaC, *i.e.*, the average number of quanta emitted per disintegration calculated on the above basis. The values of α agree with previous estimates based on general considerations.

H. N. A.

2317. *The Absorptive Power of Atomic Nuclei for γ-Rays.* **W. Kuhn.** (Zeits. f. Physik, 43. 1–2. pp. 56–65, 1927.)—Recent work on γ-ray spectra by Meitner [see Abstract 782 (1926)] and others, seems to indicate that different states may be arranged in an atomic nucleus similar to the electronic structures of the Bohr theory, and that transition between the states corresponds to an emission of monochromatic light whose frequency is connected with the energies of the states by the $h\nu$ relation. The present paper considers the estimation of the strength of the absorptions, based on the Meitner results, which are to be expected from the incidence of γ-rays on atomic nuclei in the case of resonance. An appreciable selective absorption is found to be probable, *e.g.*, from ThC″ by ThD.

H. H. Ho.

2318. *New Apparatus for the Measurement of Penetrating Radiation.* **G. Hoffmann.** (Zeits. f. Physik, 42. 8. pp. 565–569, 1927.)—Discusses the influence of Schweidler's variations of the residual current on the accuracy of measurement. A formula is obtained for the case where the residual current depends mainly on α-radiation, which enables the mean variation to be calculated in terms of the residual ionisation, the volume of the ionisation chamber and the time of the separate measurements. The accuracy of the instrument is greatly increased by diminishing the radiation from the walls of the chamber by means of a screening cage or lattice of wires and by increasing the volume inside the wire cage. A new apparatus has been constructed along these lines which is easily transportable, and gives five times greater accuracy than the smaller apparatus previously employed; this has been employed with satisfactory results in an investigation by E. Steinke [see next Abstract]. Still larger apparatus is being constructed. H. N. A.

2319. *Penetrating Radiation at Sea-Level.* **E. Steinke.** (Zeits. f. Physik, 42. 8. pp. 570–602, 1927.)—Describes measurements with the new Hoffmann apparatus [see preceding Abstract]. Photographic registration was employed in the measurement of the penetrating radiation; the sides were well screened off by large lead blocks, and over a period of fourteen days no sign of any periodic variation was observed. The variations observed were about one-tenth of those found by other authors, and seem to be due to variations in the number of α-particles entering the ionisation chamber. It is quite possible that at greater heights periodic variations of the penetrating radiations may exist, as they are not homogeneous. It was shown that the pressure of the air affects the intensity of the radiation. The softer portion of the radiation arrives mainly in the vertical direction, falling off rapidly to the sides; the value of the absorption coefficient deduced from these measurements is of the same order of magnitude as that found by other authors. The fact that the radiation is not homogeneous has been proved by measurements with lead screening up to 60 cm. thick. There is some difficulty in explaining the behaviour of the radiation in the first 10 cm. of lead. H. N. A.

2320. *The Geiger Counter Employed for Counting and Range Measurement of H-Rays.* **A. Schmutzer.** (Phys. Zeits. 28. pp. 245–250, April 1, 1927.)—Uses the methods developed by R. v. Traubenberg, including the wedge method used for determining the range of the α-particles of RaC′. It is shown how, by varying the position of the wedge with respect to the active preparation and the counter, first the α-rays from the preparation and then the H-rays can be filtered out. The β-rays from the preparation are deflected by a magnetic field, and the γ-rays are practically unaffected by the greatest thickness of the aluminium wedge employed. It is shown how from observations with different thicknesses of wedge the range in aluminium of the H-particles produced in that metal can be determined; the value obtained agrees well with that of Rutherford. The yield of H-particles was of the same order as that found by other observers. H. N. A.

2321. *Change in the Charge of Slow H-Particles.* **G. Stetter.** (Zeits. f. Physik, 42. 9–10. pp. 759–762, 1927.)—Measurements are described which show that H°-particles—*i.e.*, electrically neutral atoms—do not form a measurable fraction of the H-particles produced when atoms of the elements are disintegrated by α-rays. The scintillation method was employed, and in the first experiments the H^+-particles were deflected by a magnetic field. The spot on which they originally fell, and on which any H°-particles would continue to fall, was still luminous owing to β and γ radiation, which would mask any scintillations. In a second experiment the H^+-particles were first deflected by an electrostatic field to a point on the screen which was shielded from β and γ radiation by lead; a thin layer of aluminium sponge was then placed in the path of the particles, which would favour their discharge, *i.e.*, the formation of H°-particles; a magnetic field then deflected the H^+-particles to a new point on the screen, while any H°-particles would strike the original point. None was observed. H. N. A.

HEAT.

2322. *The Thermal Conductivity of Gases.* **E. O. Hercus** and **T. H. Laby.** (Phil. Mag. 3. pp. 1061–1064, May, 1927.)—New measurements of the thermal conductivity of gases by the hot-wire method have been recently published by Gregory and Archer [see Abstract 1381 (1926)]. They have failed to allow, however, for the temperature discontinuity between the gas and the hot wire, the existence of which has been shown by Smoluchowski, Knudsen and others. The present authors have therefore recalculated Gregory and Archer's results, allowing for this effect, using values given by Knudsen. A much better verification of Maxwell's law is found when this allowance is made, and the thermal conductivities of air and hydrogen at 0° C. after recalculation are found to be: air, $5 \cdot 85 \times 10^{-5}$; hydrogen, $40 \cdot 6 \times 10^{-5}$. These values still differ appreciably from the weighted mean of observations compiled by T. H. Laby and Miss E. A. Nelson in the International Critical Tables, *viz.* : air, $5 \cdot 33 \times 10^{-5}$; hydrogen, $37 \cdot 9 \times 10^{-5}$. T. B.

2323. *A Calibrated Thermal Resistance Plate for Measuring Heat Flow.* **C. G. F. Zobel.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 409–422, May, 1927.)—Reference is made to apparatus for measuring the flow of heat through materials. Most of these, however, such as the hot-air box, the guarded vapour box, and the electrically-heated plate, are not adaptable for thermal measurements on walls or other parts of a building already erected. An instrument called a "heat-flow meter" has therefore been designed. It consists of a thin sheet of formica $\frac{1}{16}$ in. to $\frac{1}{8}$ in. thick and 2 ft. square, the outer strip of $4\frac{3}{8}$ in. width being used as a guard ring. Its thermal conductivity K, area A, and thickness d are known, and the temperature difference $\Delta\theta$ between its opposite faces is measured by a number of thermocouples. The time rate of heat flow, H, is then deduced from the equation $H = KA\Delta\theta/d$. A description is given of the method of calibration by passing known amounts of heat through the meter, and results obtained by four separate meters for the heat flow through a slate roof in the attic of the U.S. Bureau of Mines show that the instruments are reliable and constant when proper allowance is made for the thermal resistance of the plate itself. T. B.

2324. *Freezing Points of Concentrated Solutions. Part I. Experimental Methods and the Freezing Points of Potassium Chloride Solutions.* **E. R. Jones** and **C. R. Bury.** (Phil. Mag. 3. pp. 1032–1037, May, 1927.)—The work described here was undertaken with the object of testing experimental methods; potassium chloride solutions are chosen as the subject of investigation because their freezing points have probably been studied more fully than those of any other substance. Comparison of activities calculated from the authors' and from other freezing-point determinations with those calculated from the e.m.f. of concentration cells indicate that the present measurements are more reliable than those of previous workers. The increased accuracy of the results appears to be due to the use of a brine bath, the temperature of which is kept within 0·1° C. of that of the freezing point of the solution instead of having the flask surrounded by ice. The results are compared graphically with those of previous workers. A. E. G.

2325. *Properties of the Chlorides of Sulphur. Part I. Freezing Points.* **T. M. Lowry, L. P. McHatton** and **G. G. Jones.** (Chem. Soc., J. pp. 746–756, April, 1927.)—After being heated to 100° C. in a sealed tube to bring about a condition of equilibrium, sulphur chloride gives a freezing-point curve which exhibits, not only the maxima due to the crystallisation of S_2Cl_2 and SCl_4, but also two well-marked breaks attributed to the crystallisation of SCl_2 and of a trisulphur tetrachloride S_3Cl_4, which has not been previously described. An equilibrium mixture with the composition of sulphur dichloride deposits sulphur tetrachloride on freezing, but freshly prepared mixtures of sulphur monochloride with an over-chlorinated sample of sulphur dichloride exhibit a maximum freezing point at the composition SCl_2, this disappearing when the mixture is heated at 100°. Such behaviour is ascribed to rapid production of sulphur dichloride, followed by a slower process of destruction, possibly $S_2Cl_2 + SCl_4 = 3\ SCl_2$ and $2\ SCl_2 = S_2Cl_2 + Cl_2$. T. H. P.

2326. *The Scholes Bomb Calorimeter.* (Engineering, 123. pp. 499–500, April 22, 1927.)—An improved form of bomb-type calorimeter. The bomb consists of two main parts, which may be described as the base and the body, and these are made of stainless steel machined from the solid billet. The lower end of the body is screwed into the base, a gas-tight joint being formed by a rubber ring of U-shaped section which fits into grooves formed in the body. The inner face of the body projects downwards in the form of a spigot covering the sealing ring and isolating it from the combustion space, and as a little water is placed in the base before carrying out a test, to absorb any nitric or sulphuric acid fumes caused by the combustion of the fuel, the sealing ring is completely protected. The two parts can easily be screwed together or unscrewed by hand, and the outer surfaces are knurled, to give the necessary grip. E. G.

2327. *Comparison of Thermal Diffusion of Nitrogen and Carbon Monoxide and of Nitrous Oxide and Carbon Dioxide.* **T. L. Ibbs** and **L. Underwood.** (Phys. Soc., Proc. 39. pp. 227–237; Disc., 237–238, April, 1927.)—The thermal separation obtained in gas mixtures containing nitrogen was compared with that obtained in mixtures containing carbon monoxide. A similar comparison was made of mixtures containing carbon dioxide or nitrous oxide. The analysis of the gas mixtures was done by the Shakespear katharometer. Nitrogen was found to behave similarly to carbon monoxide, and carbon dioxide had a somewhat greater effect than nitrous oxide. The gas pairs examined provide a special case for the application of the Enskog-Chapman theory, as in each case the molecular weights and the mean collision areas were the same. The molecular field of nitrogen is deduced to be similar to that of carbon monoxide, and that of carbon dioxide differs little from that of nitrous oxide. F. J. B.

2328. *Calculation of the Constants for Vapour-Tension and Fusion Curves.* **V. Fischer.** (Zeits. f. Physik, 43. 1–2. pp. 131–151, 1927.)—

The paper consists of a series of mathematical deductions with illustrations applied to practical examples. The first of these is the derivation of the constants for the vapour-tension equation and its application in the case of water vapour and nitrogen and oxygen mixtures. The calculation of the thermodynamic potential follows. The expression for the tension equation of fusion is derived and applied to antimony-lead and zinc-mercury alloys. The heat of mixture and the tracing of fusion curves are exemplified. The paper affords a useful summary of the calculations outlined above. S. G. B.

2329. *Vapour Pressure of Intensively Dried Nitrogen Tetroxide.* **J. W. Smith.** (Chem. Soc., J. pp. 867–874, April, 1927.)—It is shown experimentally that after intensive drying at room-temperature the vapour pressure of N_2O_4 is increased throughout the range 0–30° C. This agrees with the results obtained by Smits [see Chem. Soc., J. p. 2657, 1926] and supports his suggestion of a shift in the inner equilibrium towards the side of a more volatile component. That the vapour pressure takes a considerable time to reach a constant value is attributed to slow internal changes in the system consequent upon temperature change. A. B. C. L.

2330. *Adequacy of the Assumption of Molecular Aggregation in Accounting for Certain of the Physical Properties of Gaseous Nitrogen.* **F. G. Keyes** and **R. S. Taylor.** (Am. Chem. Soc., J. 49. pp. 896–911, April, 1927.)—An attempt is made to use the hypothesis of molecular aggregation in connection with the equation of state $p=\left(\frac{\mathrm{RT}}{v}-\delta\right)-\frac{\mathrm{A}}{(v+l)^2}$ to explain the observed dependence of the coefficient of $1/v$ in the virial equation on the temperature and also the curvature of the isometrics at low temperatures in the case of nitrogen. Dependence of the supposed molecular aggregation on volume and temperature in conformity with the mass law is assumed. The aggregation equation for nitrogen is obtained from the coefficient (B coefficient) of $1/v$ in the expression

$$pv=\mathrm{RT}\left(1+\frac{\mathrm{B}}{v}+\frac{\mathrm{C}}{v^2}+\ .\ .\ .\right)$$

and the values of β and A of the equation

$$p=\frac{\mathrm{RT}}{v-\beta e^{-\alpha/v}}-\frac{\mathrm{A}}{(v+l)^2},$$

which is taken as the equation of state for an invariable molecular species at not too small volumes. The dependence of the B coefficients on temperature is represented in its general characteristics, but the temperature trend of these coefficients at 300° and 400° C. found by Holborn and Otto [see Abstracts 1849 (1924) and 2549 (1925)] is not reproduced exactly and is difficult to account for unless aggregation is related to temperature and volume otherwise than assumed by the present authors. The observed isometric pressures for nitrogen are compared with those calculated from the aggregation equation

$$\log_{10}\frac{y}{(1-y)^2}=\frac{266\cdot 9}{\mathrm{T}}-1\cdot 7858-\log_{10}v\ \text{(c.c. per gramme)},$$

combined with an approximate equation of state for the unaggregated species. Except at 300° and 400° C. the curvature of the observed isometrics is reproduced. The preceding equation is used to obtain the constant-volume heat capacities of air as a function of the pressure, good agreement with the observed values being obtained. T. H. P.

2331. *Evaluation of Gibbs' Phase-Integral for Imperfect Gases.* **H. D. Ursell.** (Cambridge Phil. Soc., Proc. 23. pp. 685–697, April, 1927.)—The meaning of the term "phase-space" is first stated and the method in which it is derived. If I is the measure of the total phase-space available, interpreted in the method defined, and i that of the portion in which some particular condition is satisfied, then i/I is the probability of that condition being satisfied. The paper deals with a recalculation of the ratio in a case in which the usual method is unjustifiable. For an ideal gas composed of point molecules, the Maxwell law of velocity-distribution gives $p = nk\mathrm{T}$. To a first approximation for other molecular models the author obtains $pV = \mathrm{N}k\mathrm{T}(1 + b/\mathrm{V})$. The author then develops a more accurate expression in the form $p = N_0k\mathrm{T}[(v_a + v_b) + g']\mathrm{V}^{-1}$ for a gas of impenetrable molecules. R. S. R.

2332. *Quantum Statistics.* **K. C. Kar.** (Phys. Zeits. 28. pp. 300–302, April 15, 1927.)—Of the various methods for the derivation of the Planck radiation formula, the most elegant is due to Einstein [see Abstract 1439 (1925)]. These methods all abandon more or less the classical laws of statistical mechanics, although one by Bose [see Abstract 2812 (1924)] is noteworthy in employing the statistical mechanics of Boltzmann. In this paper the Gibbs' statistics are applied to quanta in order to derive the Planck radiation formula, the Bothe idea of the quantum molecule [see Abstract 1439 (1925)] being utilised. H. H. Ho.

2333. *Quantum Statistics.* **D. Iwanenko** and **L. Landau.** (Zeits. f. Physik, 42. 7. pp. 562–564, 1927.)—The Dirac statistics [see Abstract 294 (1927)] are shown to be based on insufficient grounds, and the Planck standpoint is opined to be perhaps the only means of obtaining the correct radiation formula. H. H. Ho.

2334. *Kinetic Derivation of Fermi's Law of Distribution.* **L. S. Ornstein** and **H. A. Kramers.** (Zeits. f. Physik, 42. 7. pp. 481–486, 1927.)—On the basis of theoretical considerations of probability, Fermi derived his law of distribution of energy from Pauli's fundamental assumption that no molecule, or only one, can exist in the k state. The authors show in this entirely mathematical paper that this fundamental assumption, if treated from the point of view of kinetic reaction, can lead to the same law of distribution. [See Abstracts 1867 (1926) and 1456 (1927).] E. F.

2335. *Limiting Volumes and Critical Isothermals of Liquids.* **Y. Tasiro.** (Phys. Math. Soc. Japan, Proc. 9. pp. 17–30, Feb., 1927.)—Graphs are given showing that for acetone, ethyl alcohol, and ethyl ether, the logarithm of the specific volume is a linear function of $1/\sqrt{p + k}$, at any temperature, p being the pressure, and k a constant, and thus the value of the volume under infinite pressure is obtained. The values so obtained vary very little with temperature. It is shown that this volume, the volume at absolute zero, and van der Waals' *b* are all different, although van der Waals' equation would make them all the same. The critical isothermal of isopentane is calculated from a formula constructed to give correct values to v_∞, v_0 and the critical volume, and is shown to agree very well with experiment. W. G. B.

2336. *Heat Relations at the Absolute Zero.* **J. E. Verschaffelt.** (Zeits. f. Physik, 43. 1–2. pp. 152–154, 1927.)—A criticism of work by W. Jazyna [Abstract 1819 (1927)]. It is pointed out that isothermal changes are quite possible at the absolute zero and that matter can contain energy at this temperature. There is no justification for the assumption that thermodynamical principles are invalid at the absolute zero. S. G. B.

2337. *Properties of Substances in the Condensed State at the Absolute Zero of Temperature.* **R. D. Kleeman.** (Science, 65. pp. 426–427, April 29, 1927.)—The author has obtained the result that the controllable internal energy and entropy of a substance or mixture in the condensed state at the absolute zero of temperature are zero. Some deductions from this result are given in the present paper. J. J. S.

2338. *Corresponding States for the Entropy of Elements.* **B. Bružs.** (J. Phys. Chem. 31. pp. 681–685, May, 1927.)—Evidence is adduced in support of the view that the value of the absolute entropy may yield valuable information with regard to states of aggregation. A fairly complete table of entropies for the elements at 298° K. is available, but it is now shown that the entropies of all elements which do not undergo marked chemical changes are equal to 22 entropy units in the fused state at their melting points. The melting point is hence termed a corresponding state for entropy. Moreover, the existing data indicate the possibility that the critical temperature also may represent a corresponding state for entropy. T. H. P.

2339. *The Entropy of Radiation.* **G. N. Lewis.** (Nat. Acad. Sci., Proc. 13. pp. 307–313, May, 1927.)—The close agreement between Planck's formula and the measured distribution of black-body radiation has led to attempts by Einstein and others to provide a theoretical basis for this formula. The present paper employs a knowledge of the entropy of radiation as a function of concentration and frequency for the calculation of the distribution of radiant energy in thermal equilibrium. The expression obtained is identical with that of Planck. S. G. B.

2340. *Determination of the Electromechanical Equivalent of Heat.* **W. Groth.** (Ann. d. Physik, 82. 8. pp. 1156–1168, May 12, 1927.)—An extension and more accurate elaboration of the method due to Paschen and Wolff, carried out in 1911. Full experimental details are given. It is found that within the limits of experimental error and accuracy of measurement, *i.e.*, within a range of 5 in 10,000, there is no perceptible difference between the international and the absolute electric unit of measurement. S. G. B.

SOUND.

2341. *Pinhole Probe Measurements with Massive Cylindrical Air Columns.* **C. Barus.** (Nat. Acad. Sci., Proc. 13. pp. 223–227, April, 1927.)—Extends the work of previous papers to experiments with a long, slender horn (40 cm. long) and to cylindrical tubes (28 cm. long, 2·8 cm. diam.). Some theory is given. W. H. Ge.

2342. *Direct Comparison of the Loudness of Pure Tones.* **B. A. Kingsbury.** (Phys. Rev. 29. pp. 588–600, April, 1927.)—Deals with frequencies from 60 to 4000 per sec. and intensities from the threshold to 90 T.U. above the 700 frequency threshold. The loudness of eleven pure tones was studied by adjusting the voltage applied to a telephone receiver. The results of observations of 11 men and 11 women show that if the amplitudes of pure tones are increased in equal ratios the loudness of low-frequency tones increases much more rapidly than that of high-frequency tones. For frequencies above 700 per sec. the rate is nearly uniform. As *loudness unit* the least perceptible increment of loudness of a 1000 per sec. tone was used. The variability of the data from which the averages were computed was separated into a factor expressing dissimilarity of ears and another expressing errors of observers' judgment. There was no level at which the variances were a minimum. Dissimilarity of ears causes more variation than errors of observers' judgment. The variances showed no significant sex difference. W. H. Ge.

2343. *Bowed Strings.* **M. N. Mitra.** (Ind. Journ. Phys. 1. pp. 311–328, May, 1927.)—Roman's generalised theory has been experimentally verified. The experimental records show that a point lying ahead of the bowed region has a greater velocity than that of the bow, whilst a point behind the bowed region has a lower velocity. The point having the same velocity as that of the bow lies always within the bowed region, contrary to the suggestion of Kar. By suitable adjustment of the bow speed and pressure it was possible to obtain the Helmholtzian type of vibration at points between $l/4$ and the bridge. The Helmholtzian relation is approximately true for all except nodal points (*e.g.*, $2l/9$ or $2l/11$) or thereabouts. The velocity ratio v_1/v_2 of ascent (v_1) and descent then rises to that of the fourth, fifth or sixth type of vibration. W. H. Ge.

2344. *Acoustical Testing of Bricks.* **J. Obata.** (Frank. Inst., J. 203. pp. 647–659, May, 1927.)—The brick under test was held in the hand and struck with a steel hammer, the resulting sound being recorded by a condenser microphone and oscillograph. The observed frequency of the note is always less than that calculated by the theory for the thin free-free bar. An empirical relation is given as compressive strength (in lbs. per sq. in.) = $100n/35 - 1500$, where n is the frequency of the note. The change in pitch due to absorption of water is accounted for by the density change. The records, of which 27 are reproduced, are similar to those for the xylophone and show some interesting damping relations. W. H. Ge.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2345. *Momentum of the Conducting Electron.* **A. E. Malinowski.** (Zeits. f. Physik, 42. 4. pp. 319–322, 1927.)—Describes an experiment in which a current (0·54 ampere) is caused to flow in a ring, half of which is copper and half bismuth, by the heating effect of an arc lamp. The bimetallic ring is suspended in a high vacuum by a fine tungsten wire. The ring is examined by means of a mirror and telescope so arranged that very small movements can be observed. No motion was observed as a result of the current flowing, and the author concludes that either (1) the self-induction of inertia of the conducting electron is not essentially affected, or (2) the velocity of motion of the electron is extraordinarily high (about 10^6 cm./sec./volt./cm.). A theoretical discussion of this negative result is given. G. E. B.

2346. *The Derivation of Minkowski's Equation for the World-Line of an Electron by the Calculus of Variations.* **V. Bursian.** (Zeits. f. Physik, 42. 5–6. pp. 443–447, 1927.)—Shows that the four-dimensional Lagrangian function must contain the rest-mass of the electron; that used by Frenkel in his recent textbook, where the mass is used as an undetermined multiplier, makes this factor vanish identically. W. G. B.

2347. *Lagrangian Functions and Schrödinger's Rule.* **H. Bateman.** (Nat. Acad. Sci., Proc. 13. pp. 326–330, May, 1927.)—In a recent paper Schrödinger [see Abstract 1293 (1927)] has extended a rule, used by writers in the theory of gravitation, for deriving a stress energy tensor from a Lagrangian function, and has illustrated its application in the case of the tensor which he has associated with the system of equations proposed by Gordon [see Abstract 1417 (1927)] for electricity distribution throughout space. The rule is now applied to various Lagrangian functions and found to be generally applicable. H. H. Ho.

2348. *Internal Magnetic Field in Ferromagnetic Conductors of Rectangular, Triangular and Elliptic Cross-Sections.* **M. Strütt.** (Archiv f. Elektrot. 18. pp. 190–194, April 7, 1927.)—In continuation of his previous work [see Abstract 1098 (1927)], the author investigates the internal magnetic field of straight, infinitely long conductors of ferromagnetic material having the above cross-sections. The approximate solutions obtained are based on the assumption that the boundary of the cross-section is a line of induction. A. H.

2349. *Potential of Systems of Electric Charges.* **C. N. Wall.** (Phil. Mag. 3. pp. 660–688, April, 1927. Supplement.)—A method is indicated which leads to expansions of the potential into double Fourier series, into series of spherical harmonics, and into series of cylindrical harmonics. The potential due to a point charge is expressed as a special form of Whittaker's general solution of Laplace's equation. The paper deals with a line system of alternately positive and negative point charges forming a series of doublets, and with the expansions indicated above for an infinite set of positive and negative charges distributed through space as doublets according to a certain regular scheme. It is found that the expansion in spherical harmonics has in some cases advantages over the expansion in a double Fourier series. The expansion in cylindrical harmonics turns out to be very cumbersome. Numerical values are calculated for certain points in a simple case and are given in a table. The author has also considered the case where the electric doublets make an angle with the direction in which they are distributed in space; it seems probable that no special difficulties would arise in solving this problem. H. N. A.

2350. *Mechanism of a Thunderstorm.* **G. C. Simpson.** (Roy. Soc., Proc. 114. pp. 376–401, April 1, 1927.)—In 1909 the author described a theory of the origin of the electricity in thunderstorms based on the observation that when a drop of water is broken up in the air the water obtains a positive charge, while the corresponding negative charge is given to the air. Little attempt was then made to work out the details of the processes involved in a thunderstorm. Only the most general consideration was given to the quantities involved and no description of the nature of the lightning discharges was attempted. Recently numbers of papers have been published recording the electrical fields associated with thunderstorms and the sudden changes in the field which accompany lightning discharges. The authors of these papers have expressed the opinion that their observations of changes in field-strength do not agree with what is to be expected according to the theory which the author propounded. This opinion was most strongly expressed in the paper by Schonland and Craib. A detailed description is here given of the mechanism of a thunderstorm according to the theory in which the separation of electricity is brought about by the breaking of raindrops. The orders of magnitude of the meteorological and electrical quantities involved are investigated and shown to be in accordance with observations. The observations made by Schonland and Craib in South Africa of changes of electrical field-strength produced by lightning discharges are examined in the light of the theory and found to be in complete accord. A. E. G.

2351. *New Explanation of the Maintenance of the Earth's Negative Charge.* **W. Anderson.** (Zeits. f. Physik, 42. 5–6. pp. 475–478, 1927.)—The author uses the idea that solar and stellar energy originate from the transformation of matter into energy and the whole (or almost the whole) comes from protons. For the sun, from the known rate of loss of energy, he finds $2 \cdot 54 \times 10^{36}$ protons are destroyed per second. The liberated electrons are set free in the corona and disperse into space. J. H. Moore's observations on the solar eclipse of 1922 gave a loss of $2 \cdot 76 \times 10^{36}$ protons per sec. This gives a current density for the sun's surface of $6 \cdot 66 \times 10^{-6}$ amps./cm.^{2} directed towards the sun. The author considers this same process exists in dark heavenly bodies and in the earth, although at a much slower rate. To maintain the charge in the earth's surface $7 \cdot 65 \times 10^{21}$ protons per sec. must be destroyed, *i.e.*, a production of $1 \cdot 144 \times 10^{19}$ ergs/sec. This is, however, only $4 \cdot 6$ % of the total radiation loss from the earth, and thus other processes exist. The surplus electrons from the interior reach the earth's surface and attract positive ions from the air and are neutralised while the free electrons will be driven from the earth's surface. Experiments hitherto have failed to confirm the view that the earth's negative charge is derived from the incoming electronic stream from space, and the author considers the electrons originate from the interior of the earth. R. S. R.

2352. *Maintenance of the Earth's Charge by the Lightning Current.* **H. Benndorf.** (Phys. Zeits. 28. pp. 260–261, April 1, 1927.)—Discussing Wigand's explanation [see Abstract 1489 (1927)], which he considers inadequate, the author comes to the following conclusion: The fact that more flashes pass from earth to cloud than in the contrary direction is not in itself sufficient to account for the maintenance of the earth's charge. These flashes presumably compensate only a portion of the surplus of positive electricity brought to earth by the precipitations. The maintenance of the charge by flashes could be explained only if it were proved either that the lightning current and conduction current earth-cloud exceeds the downward convection current by 1400 amperes, or that there is a continuous current of 1400 amperes from the clouds of the storm regions to the upper, strongly conductive atmospheric strata. It would then follow that there must be a corresponding earth-cloud current. E. F.

2353. *Earth's Charge, Lightning Current and Precipitation Current.* **A. Wigand.** (Phys. Zeits. 28. pp. 261–263, April 1, 1927.)—Referring to Maurer's deductions [see Abstract 1839 (1927)], the author remarks that if further observations show that at sea the predominant direction of the lightning current is from cloud to earth we must, in estimating the total direction of the flashes, take into consideration the fact that, according to Brooks, in his storm statistics, the total number of storms over the land and coastal waters is 2½ times as great as at sea, notwithstanding the much greater ocean area. As against some ten cases of ships struck by lightning we have more than 1000 observations over land which establish the fact that the predominant direction of the current is earth-cloud. Replying to Benndorf's criticisms: (1) The flashes directed upwards from the cloud must carry away part of the cloud charge into the upper air strata. It is to be presumed that they carry the positive charge corresponding to the negative surplus charge of the flashes proceeding downwards to the earth. (2) Pending further measurements it seems premature to say anything about the magnitude of the perturbed vertical conduction current downwards and upwards from the cloud. (3) The view that the positive surplus of the precipitation charge appears to be of a smaller order of magnitude than the negative surplus charge of the flashes directed earthwards is based chiefly on Schindelhauer's Potsdam measurements [Meteorolog. Zeits. 33. p. 599, 1913] and Simpson's Simla measurements [Phys. Zeits. 14. p. 1057, 1913] of the earth's total precipitation charge, the result of which confirms the contention that this factor does not constitute an argument against the possibility of the maintenance of the earth charge by the lightning current. Regarding the origin of the high tension storm field, the author's own balloon observations lead him to differ from Benndorf's view that it is due to the spraying effect of the drops of water in the ascending air current. Stress is again laid on the need of further observation data, in the absence of which any explanation of the phenomenon must be to some extent conjectural. [See also Abstract 1489 (1927).] E. F.

2354. *Electricity of Dust Clouds. Part I.* **G. B. Deodhar.** (Phys. Soc., Proc. 39. pp. 243–248; Disc., 248–249, April, 1927.)—Observations have been made qualitatively on a considerable number of dusts by blowing a large volume of air at high speed over them and measuring the resulting charge. The results agree with those of Rudge in some cases only. The electrification produced is frictional in character. From quantitative tests $NaNO_3$ is found to be more effective than KNO_3 and both better than KCl and NaCl. Tests on graded dusts of different sizes show that, other things being equal, the voltage developed by blowing increases very rapidly as the size decreases. The results are to be extended. The bearing of these facts on the electrification of dust clouds and dust storms is dealt with. In the *Discussion*, **P. E. Shaw** stated that the factor of humidity affects the result obtained and that the charge measured is a net one due to charges on the particles and on the ionised air, to impact on the walls and gauge of the chamber, and to ions emitted to the air, and these factors are not disentangled. **J. H. Coste** suggested that better grading of particles could be obtained by sedimentation and that the air might have been contaminated with dust before reaching the powder tested. R. S. R.

DISCHARGE AND OSCILLATIONS.

2355. *Construction of Mercury Arc Lamps for Laboratory Use.* **D. S. Ainslie.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 354–355, April, 1927.)—The lamp and method of construction described in this paper were designed so as to be as simple as possible in order to render mercury arc lamps available in laboratories with a limited equipment for this type of work. The lamp described is about 20 cm. long and is operated with the arc vertical, giving a source of light suitable for spectroscopic experiments. A diagram and full details of the lamp are given. The current consumption is approximately 3 amperes with a fall of potential across the terminals of 16 to 20 volts. A. E. G.

2356. *Energy Distribution and Efficiency of the Quartz Mercury Arc as Functions of Arc Voltage, Current Density and Tube Diameter.* **D. C. Stockbarger.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 356–363, April, 1927.)—By employing the filter-thermopile method of making radiation analyses, the energy distributions of the radiation emitted by a number of special quartz mercury arcs is determined over wide ranges of arc voltage at several constant-current densities. The results indicate that high-voltage, high-current density and large tube diameter are favourable for high percentage of ultra-violet radiation. For any given tube diameter and current density, there exists an arc voltage at which the infra-red percentage reaches a maximum. The infra-red maximum appears at lower voltages as the current density or tube diameter is increased. It is shown that intensity is a function of current and arc voltage treated as separate variables rather than of the product of these two. The intensity of a spectral group may increase, remain constant, or decrease with increasing input to the burner. The total efficiency expressed as the ratio of radiant power to electrical input increases with increasing arc voltage, current density and tube diameter. Under given electrical conditions the efficiency can be increased by heating the luminous tube. A. E. G.

2357. *Low-Voltage Arcs.* **G. Mierdel.** (Phys. Zeits. 28. pp. 344–360, May 1, 1927.)—In the first part of this paper the author collects and summarises the results of numerous workers on low-voltage arcs. The various theories that have been put forward to explain the observed phenomena are then considered and the possible methods of ionisation in the discharge chamber are fully discussed. It appears that since such effects as thermal or photoelectric emission, impact of positive ions or secondary collisions do not afford a satisfactory explanation of the phenomena of low-voltage arcs, it is necessary to assume that all normal arcs of this type and non-oscillatory must possess a kathode fall of potential of the same order of magnitude as the excitation potential of the gas in question, and that the field in the other part of the discharge is directed in opposition, so that the measured potential difference between the electrodes is less than the excitation potential. The explanation of the abnormal low-voltage arc is somewhat different. Again assuming freedom from oscillation, it appears probable that the ionisation of the atom can in this case take place in two stages, complete ionisation by electron impacts following excitation due to absorption of resonance radiation. The theory advanced gives an explanation of all the effects observed with low-voltage arcs, including the decrease of minimum potential with increased kathode temperature and with increased pressure.
A. W.

2358. *Relighting of a Neon Lamp at Voltages below the Striking Potential.* **R. R. Nimmo.** (Phys. Soc., Proc. 39. pp. 238–241; Disc., 241–242, April, 1927.)—When the discharge through a neon lamp is interrupted the number of ions which were present during the discharge diminishes rapidly. The possibility of restarting the discharge at voltages below the striking potential was investigated. The results showed that the time of interruption, without putting out the lamp, was of the order of 50 micro-seconds, and that it depended on the voltage across the lamp and on the current passing through it. F. J. B.

2359. *The Gradient in the Positive Column of the Glow Discharge.* **A. Güntherschulze.** (Zeits. f. Physik, 41. 10. pp. 718–736, 1927. From the Reichsanstalt.)—In the present work the mean free wave-length l is introduced as variable, which is obtained from the measured pressure and the partly measured, partly calculated, temperature-rise in the discharge track. The gradient at constant l is then independent of the current strength in the glow discharge in N_2 and H_2, while in Ne, at higher current densities, it diminishes a little with increasing current density. For all three gases the theoretical equation: gradient $= c(l^{m-1})/r^m$ is valid; in the case of N_2 and H_2, $m = \frac{1}{3}$ and for Ne, $m = 1$; that is, in Ne the gradient is independent both of the wave-length and of the gas pressure. With respect to the dependence of the gradient on r, these results are in accord with those of Schottky from his theory of the Ambi-polar diffusion of the positive column. It is shown that the above considerations are valid in the whole pressure region in which a proper glow discharge is present. A. E. G.

2360. *Electrostatic Field of a Space Charge. Part I.* **O. Emersleben.** (Ann. d. Physik, 82. 6. pp. 713–775, April 4, 1927.)—A mathematical paper in which are determined Green's functions for electrons between (*a*) two parallel planes, (*b*) two intersecting planes, and (*c*) two concentric spheres. The results of the theoretical investigation are applied to determine the electrostatic field of a space charge, and also to investigate the details of the phenomena occurring in electron tubes, particularly triodes. A. W.

2361. *Electric Glow Emission of Metals with Changing Conditions of the Kathode Materials.* **A. Goetz.** (Zeits. f. Physik, 42. 5–6. pp. 329–374, 1927.)—This paper forms a kind of preliminary communication on the subject and deals especially with the experimental research conditions and the apparatus for obtaining the electric glow fusion diagram. There is also a review of previous work. Among the points specially considered are: The high vacuum fusion oven; determination of the temperature; the anode; methods of evacuating and degassing; regulation of the temperature; arrangement for determining J as function of the temperature; arrangement for determining J and T as functions of the time; the interrupter; the connections; the determination of the pressure. [See also Abstract 1118 (1927).] A. E. G.

2362. *Potential Difference between Positive Layers in Argon and Neon.* **F. M. Penning.** (Zeits. f. Physik, 41. 10. pp. 769–774, 1927.)—The p.d. between the stationary positive layers in argon and neon is found to be approximately independent of pressure and current density. For argon the value 11·9 volts was found, approximately equal to the excitation voltage of the $I - s$ condition; for neon 18·5 volts, approximately equal to the excitation voltage of the $2 - p$ condition. These results are discussed. For the potential difference between the moving layers in argon the following values were obtained, showing marked dependence on current density (7 volts for 0·05 amp.; 3 volts for 0·4 amp.). With neon, krypton and xenon, no measurements were made on moving layers. A. B. W.

2363. *Analysis of Beams of Moving Charged Particles by a Magnetic Field.* **W. A. Wooster.** (Roy. Soc., Proc. 114. pp. 729–744, May 2, 1927.)—There are two ways in which the analysis of a heterogeneous beam may be carried out. In one the particles, projected at right angles to the field, are deviated through small angles and appear as bands on a photographic plate; whilst in the other, which is alone considered here, the tracks of the particles are semicircles, converging to a narrow line on a photographic plate placed in a suitable position relative to the source. The main purpose of this paper is to point out a method by means of which the "magnetic spectrometer" may be used to the best advantage. This method consists in first finding the structure of the line produced by the apparatus for certain given conditions of size, source, slit, etc., and then modifying them to give the particular form of line required. The structure of the line in any given case can be obtained approximately from the curves here given, and for a more accurate determination a method is also described. The application of the analytical method to the determination of the velocity distribution of particles passing through thin sheets of matter is also pointed out. A. E. G.

2364. *Secondary Magnetic Rays at Electrodes.* **E. Goldstein.** (Zeits. f. Physik, 40. 4. pp. 276–282, 1927.)—The author has previously described [see Abstract 820 (1926)] the generation of secondary magnetic canal rays at the narrow parts of the lumen of discharge tubes. It is now shown that these secondary rays may also occur at the metal anode itself. Their arrangement depends on the density of the gas and on the direction of the magnetic field; it also depends on the strength of the field. A. E. G.

2365. *Reply to G. P. Thomson's Paper on Measurements of the Scattering of Hydrogen Canal Rays.* **R. Conrad** and **J. Koenigsberger.** (Zeits. f. Physik, 42. 4. pp. 323–326, 1927.)—Thomson has recently criticised the measurements of Conrad [see Abstract 1496 (1927)]. The authors show that the criticism is not justified, and consider that Thomson's first measurements, which differ considerably from the results of Conrad, are unreliable. Coulomb's law holds for the scattering of hydrogen nuclei by hydrogen molecules for the small scattering angles and velocities employed by Conrad at least to within 10 or 20 %. The difficulty of calculating exactly the effect of different factors, including the action of the electrons and multiple scattering, prevents more accurate agreement with the inverse square law. H. N. A.

2366. *Thermionic Emission and the "Universal Constant" A.* **E. H. Hall.** (Nat. Acad. Sci., Proc. 13. pp. 315–326, May, 1927.)—This paper continues the author's previous work of showing that certain ideas embodied in the dual theory of electric conduction within metals are capable of illuminating the field of electronic emission. The first question discussed is that free electrons within metals share the energy of thermal agitation, the work of Richardson, Millikan, Dushman and Bridgman being reviewed. The author then derives and discusses a form of emission equation which embodies the concepts of the dual-conduction theory and the constant, keeping to the classical kinetic conception of the free electrons within a metal and modifying without rejecting Richardson's classical kinetic theory of thermionic emission. H. H. Ho.

2367. *Gasfilled Photoelectric Cells.* **N. R. Campbell.** (Phil. Mag. 3. pp. 945–959, April, 1927.)—A study was made of the relation between the current, voltage and illumination of gasfilled photoelectric cells in the region immediately before the potential at which the independent discharge starts. The behaviour of spherical and plane cells was found to be essentially similar. In both cases the "limiting curve," or locus of points at which the light-controlled discharge passes into one almost independent of the light, consists of two parts, on the upper of which the passage from one to the other form of discharge is continuous and stable, and the magnification of the primary photoelectric current by the discharge is very much greater than on the lower. The difference between the two types of cell is that illuminations which are practically important lie wholly on the lower portion in the spherical cell, but not in the plane cell. Study of that portion of the characteristic which is normally unstable, carried out with a current-limiting device in series with the cell, showed that the main features of the observed phenomena are in accordance with expectations based on the accepted theory of the glow discharge, but there are minor features which present some difficulty. The unstable portion of the characteristic may be used for measuring small illuminations. A. W.

2368. *Gasfilled Photoelectric Cells.* **N. R. Campbell.** (Phil. Mag. 3. pp. 1041–1051, May, 1927.)—In a previous paper [see preceding Abstract] attention was drawn to the variation of the form of the current-voltage

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characteristic of a gasfilled photoelectric cell with the illumination incident upon it. An account is now given of four methods of using such cells for the detection or measurement of light: (1) The response of the cell used in the ordinary manner to a given change of illumination can be considerably increased by the application of a constant "priming" illumination from an independent source. This method is only useful with "plane" cells exposed to moderate illuminations. (2) The method in which the photoelectric current is passed through a high resistance, the p.d. at the ends of which is measured, can be improved by using a thermionic current limiter in place of an ohmic resistance. The improvement is still greater if a suitable unstable portion of the characteristic is used. The method is suitable for "spherical" cells when the range of illumination is not too great. (3) The third and fourth methods are based on the change of frequency of the oscillations on the unstable part of the characteristic when the illumination is changed. In the third method a part of the characteristic is used near the sparking potential which terminates the Townsend discharge. "Spherical" cells must be used. The method, which may have applications in astronomy, is extremely sensitive and convenient; it can detect a candle at 1 k.m. distance without any elaborate or sensitive apparatus. (4) The fourth method also uses the change of frequency with illumination, but works on that part of the characteristic where the unstable portion passes into the stable glow discharge. "Plane" cells must be used. A. W.

2369. *Photoelectric Experiments with Platinum laden with Ammonia.* **H. Leupold.** (Ann. d. Physik, 82. 6. pp. 841–872, April 4, 1927.)—This paper is divided into two sections. In the first it is shown that ammonia at atmospheric pressure has an absorption band in the ultra-violet which extends from wave-length 230 $\mu\mu$ up to 217 $\mu\mu$. The maximum of this band is found to be at wave-length 221 $\mu\mu$. If a thin layer of ammonia is made to adhere to a quartz plate, it is found that this layer has an absorption coefficient β which is different from α, the coefficient of ammonia gas. In the second part the method of loading the platinum with ammonia is first described. It is found that the presence of ammonia considerably increases the photoelectric sensitivity of the platinum as compared with the presence of air. It seems owing to the marked increase of photoelectric sensitivity, as if the red limit is displaced towards longer waves owing to the ammonia. In the region of the absorption band the ammonia produces a marked lowering in the number of photoelectric electrons released. A. E. G.

2370. *The Influence of Water of Crystallisation on the Photoelectric Effect in Crystal Hydrates.* **A. Predwoditelew** and **W. Blinow.** (Zeits. f. Physik, 42. 1. pp. 60–76, 1927.)—In this paper the influence of water of crystallisation on photocurrent strength has been investigated for $CuSO_4 . 5H_2O$, $AlK(SO_4)_2 . 12H_2O$, and $Pb(C_2O_2H_3)_2 . 3H_2O$ while undergoing dehydration *in vacuo*. It has been established that by dehydration the photocurrent increases according to the law $J_0^4 - J^4 = bc$ (where c denotes the amount of water of crystallisation present at the given moment). Illustrative curves for dehydration and photocurrent are included, and a connection established between the phenomena recorded and Werner's theory concerning the constitution of complex inorganic compounds. H. H. Ho.

2371. *Direction of Emission of Photoelectrons.* **P. Auger.** (J. de Physique et le Radium, 8. pp. 85–92, Feb., 1927.)—The photoelectrons detached from matter by a beam of X-rays are not projected uniformly in all directions. For a non-polarised radiation, the density of the emission in a certain direction depends only on the angle which it makes with the direction of propagation of the X-rays. The spatial repartition which results from this relation has been studied by the method of condensation, using simultaneous photography in two rectilinear directions. Measurements, representable graphically, have been made in six different cases which serve to give the principal characteristics of the repartition : (1) the general form is well defined and results in a wide distribution of part and the remainder in a " privileged " direction of emission near 90° ; this does not vary with experimental conditions ; (2) it can be denoted, in every case, by the value of the mean angle, *i.e.*, the semi-angle of the apex of the core which divides it into two parts of equal importance ; this angle depends on the frequency of the incident X-rays and the atomic number of the element which emits the photoelectrons. A. B. W.

2372. *Repartition in Space of the Directions of Emission of Photoelectrons.* **P. Auger and F. Perrin.** (J. de Physique et le Radium, 8. pp. 93–112, Feb., 1927.)—When two luminous waves (in the same direction, frequency and intensity, but of independent phases, polarised linearly in perpendicular planes) are superposed, a natural luminous wave is obtained of which the effects have a symmetry of radiation around the direction of propagation. The application of this principle gives a necessary condition which may be used to satisfy the repartition in space of the directions of emission of electrons produced in the photoelectric process. It is thus considered possible to prove the impossibility of certain forms of repartition, particularly those which result from the theories of W. Bothe and F. W. Bubb. [See Abstracts 1825 and 2518 (1924).] A. B. W.

2373. *Theory of Photoelectric Effects.* **N. v. Raschevsky.** (Zeits. f. Physik, 42. 8. pp. 627–630, 1927.)—The principal question discussed here is the possible explanation of wave mechanics. The previous work of Wentzel [see Abstract 1500 (1927)], Born [see Abstract 568 (1927)], and Madelung [see Abstract 1286 (1927)] is discussed briefly, and the action of a light wave on an atom is investigated according to the wave mechanics in the Schrödinger-Madelung interpretation of the same.
A. E. G.

2374. *The Transformation Period of the Initial Positive Air Ion.* **Leila M. Valasek.** (Phys. Rev. 29. pp. 542–545, April, 1927.)—Erikson has shown that when first formed in air at atmospheric pressure the positive ion has a mobility of 1·87 cm./sec. per volt/cm., but that it quickly changes over into an ion having a mobility of 1·36. By a method essentially the same as that used by Erikson, a quantitative study was made of the rate of transformation. It was found to be dependent on the humidity of the air. At a relative humidity of 32 %, the half-value period was found to be 0·0132 sec. ; at a relative humidity of 80 %, it is 0·0354 sec. [See also Abstract 1435 (1926).] AUTHOR.

2375. *Ionisation by Collision.* **H. G. L. Huxley.** (Phil. Mag. 3. pp. 1056–1061, May, 1927.)—In a recent paper [Abstract 1849 (1927)] Taylor has advanced a theory of sparking potentials which differs from the usually accepted theory of Townsend in some important particulars. It is shown in the present paper that on Taylor's hypothesis it is impossible to explain the principal features of the phenomena of discharges either between parallel plates or between coaxial cylinders. Various results are cited which are in contradiction with Taylor's theory. A. W.

2376. *Nature of Phosphorus Ionisation. Part I.* **W. Busse.** (Ann. d. Physik, 82. 7. pp. 873–911, April 29, 1927.)—The results are given of measurements of the mobilities of the largest ions produced by the slow oxidation of phosphorus [see Bloch, Abstracts 1050 (1903), 610 (1904); Harms, Abstracts 821 (1903), 1122 (1904)]. These ions arise in immediate contact with the phosphorus. No difference is observable between the mobilities of the two types of ions, but the values obtained fluctuate widely and, for ions of similar age, are much greater than those found by Harms, this being attributable to the varying influences of temperature and moisture. The growth of the ions with age may be readily followed, but no exact maximum limit of size exists. On the assumption of single charges, the maximum radii for an age of 8 seconds is from 2 to 4 × 10^{-6} cm. Measurement of the distribution of size by means of the double condenser indicates a continuous region of ionic magnitudes, so that the ions originate only partly at the phosphorus. The transparency of fluorspar to the ionising action of phosphorus noted by Downey (Chem. Soc., J. 125. pp. 347–357, 1924) is not confirmed. The oxidation takes place in absence of water vapour [see Abstract 666 (1904)], which, however, exerts a catalytic influence on the reaction. [See Abstract 819 (1927).] T. H. P.

2377. *Self-tuning Crystal.* **K. Lichtenecker.** (Zeits. techn. Physik, 8. 4. pp. 161–163, 1927.)—According to Seidl [see Abstracts 1441 (1926) and 1125 (1927)] a metal-crystal contact in the circuit of a singing arc-light may give a continuous tone of its own. In the present paper it is shown that the cause producing this phenomenon is not brought about by electromagnetic oscillations, but that the fall in temperature at the metal point must be taken into consideration. A. E. G.

2378. *The Character Graph and the Dynamic Characteristics of an Electron Tube.* **B. Ostroumoff.** (Zeits. techn. Physik, 8. 4. pp. 163–164, 1927.)—A description is here given of the apparatus necessary for obtaining automatically the different electrical characteristics. A method is also described for getting the dynamic characteristics of an electron tube. A scheme of the character graph and a diagram showing the connections used for obtaining the dynamic characteristics are given. As proof of the value of the apparatus two photographs are given of the characteristics obtained. A. E. G.

2379. *Oscillatory Circuits Coupled by Iron-Cored Coils. Part II.* **H. Winter-Günther.** (Zeits. f. Hochfrequenztechn. 29. pp. 103–114, April, 1927.)—A theoretical and experimental study was made of the case of two oscillatory circuits coupled by means of a single common coil wound on a closed iron core (1) when the circuits were tuned to the same frequency, (2) when the circuits were tuned to different frequencies. The effects observed are illustrated by a series of interesting diagrams which show the changes due to different circuit conditions. [See Abstract 2132 (1927).] A. W.

2380. *Oscillatory Circuits coupled by Iron-Cored Coils. Part III.* **H. Winter-Günther.** (Zeits. f. Hochfrequenztechn. 29. pp. 148–150, May, 1927.)—In this paper a discussion is given of the current-potential characteristics of condenser circuits containing iron-cored coils with weak fields. The discussion is based on Zenneck's theory of such circuits. [See preceding Abstract and 2132 (1927).] A. W.

2381. *Intensity of Radiation from a Source of Electric Waves when the Electric Constants of the Medium in the Neighbourhood of the Source are different from the Electric Constants at a Distance from it.* **H. M. Macdonald.** (Roy. Soc., Proc. 114. pp. 367–401, April 1, 1927.)—If a simple oscillator is close to a perfectly conducting plane with its axis perpendicular to the plane, the magnetic force at the point (r, θ), where r is the distance of the point from the oscillator, and θ is its angular distance from the axis of the oscillator, is the real part of $2Ae^{3\pi i/4+ikVt}r^{-\frac{1}{2}}K_{\frac{3}{2}}(ikr)\sin\theta$, and the real part of $Ae^{3\pi i/4+ikVt}r^{\frac{1}{2}}K_{\frac{3}{2}}(ikr)\sin\theta$ is the magnetic force due to the oscillator alone. The rate of transfer of energy across the surface of a sphere enclosing the oscillator is $2\pi A^2/3KkV$, and the rate of transfer of energy from an oscillator A_1, when there is no conducting plane, is $\pi A_1^2/3KkV$, and therefore, if the energy supplied is the same in both cases, $A_1^2 = 2A^2$, that is, the effect of the conducting plane is to increase the amplitude of the waves at any point in the ratio $\sqrt{2}$ to 1, or to double the intensity. The object of the present paper is to investigate the corresponding problem when the electric constants of the medium are not the same everywhere, and it is shown that, if K, μ are the electric constants of the interior space containing the oscillator, and K', μ' are the electric constants of the space external to this, the amplitude of the oscillations is to the amplitude of the oscillations when $K' = K$ and $\mu' = \mu$, in a ratio which lies between $(\sigma/\sigma')^{\frac{1}{2}}$ and $(\sigma'/\sigma)^{\frac{1}{2}}$, where $\sigma = (K/\mu)^{\frac{1}{2}}$, $\sigma' = (K'/\mu')^{\frac{1}{2}}$, and the wave-length of the oscillations is small compared with the linear dimensions of the internal space, and the oscillator is not near the boundary of the two spaces. A. E. G.

2382. *Anomalies in the Propagation of Short Waves.* **R. Bureau.** (Comptes Rendus, 184. pp. 1078–1080, May 2, 1927.)—Various anomalous results observed in the propagation of waves between 20 and 115 metres wave-length over distances of 10 to 1500 kilometres lead to the conclusion that we are concerned not with a single ionised layer in the upper atmosphere but with two such layers, or with a state of affairs such that the ionisation possesses two maxima at different heights. If the latter is the case the observed effects will be the same as if there were two layers at the heights where the respective maxima are found, and on such an assumption it is possible to explain the anomalous results found experimentally. The study of the variations of terrestrial magnetism has led to the postulation of two ionised layers at heights of about 50 and 90 kilometres, and the existence of such layers is now seen to account for effects observed in wave propagation. A. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2383. *Unit of Specific Electrical Resistivity and Conductivity.* **P. Melchior.** (Zeits. techn. Physik, 8. 4. pp. 154–157, 1927.)—Discusses units of resistance and of conductivity, with special reference to conversion to other systems. Alternative expressions for the usual equation $R = pl/F$ (p = specific resistance, l = length, and F = area of cross-section), which assist in conversion, are given. The paper also contains tables and lists of useful conversion factors. G. E. B.

2384. *Electron Conduction in Crystals.* **H. Lenz.** (Ann. d. Physik, 82. 6. pp. 775–793, April 4, 1927.)—An electron current in crystals can be produced by irradiation with light at right angles to the electric field and also by bombardment with kathode rays in the direction of the electric field. That both are electron currents the appearance of the Hall effect shows. From the measurement of the Hall effect at room-temperature and with liquid air it follows that the length of the free path of the electrons down to the temperature of liquid air is independent of the temperature. The electron current excited by kathode rays is down to the temperature of liquid hydrogen independent of the temperature. The photoelectric current produced in the diamond by radiation from the undecomposed light of the quartz-mercury lamp is strongly dependent on temperature above 125° absolute. It appears that for the explanation of this some yet unknown factor must be assumed. From 20 to 125° absolute the current is approximately independent of the temperature. J. J. S.

2385. *Hall Effect for Bismuth in Weak Magnetic Fields.* **F. Klaiber.** (Zeits. f. Physik, 43. 1–2. pp. 66–68, 1927.)—By means of evaporation in high vacua, bismuth layers have been obtained for which the Hall effect has been measured in fields between 0·07 and 5 gauss. The primary current strength employed varied between 10^{-2} and 1 amp. The Hall constant R does not show the abnormal behaviour in weak fields found by Craig. [See Abstract 2182 (1926).] H. H. Ho.

2386. *Thermoelectric Effect in Single Crystal Zinc.* **E. G. Linder.** (Phys. Rev. 29. pp. 554–565, April, 1927.)—In continuation of previous work [see Abstract 602 (1926)] the observed values are given of the thermal e.m.f. against copper of six single crystal wires of zinc, of which the orientations of the main crystallographic (hexagonal) axis with respect to the wire axis range from 11·4° to 90°. The temperature interval was from − 182° to 475° C. From the data are calculated the thermoelectric power, Peltier coefficient and difference of the Thomson coefficients for $Zn\perp$ against $Z\|$. The thermoelectric powers of liquid Zn against solid single crystal Zn of different orientations and against polycrystalline Zn are given. J. J. S.

2387. *The Nature of Dielectric Losses.* **H. Schiller.** (Zeits. f. Physik, 42. 2–3. pp. 246–252, 1927.)—A critical note on a paper of the same title by K. Sinjelnikoff and A. Walther [Abstract 1878 (1927)] shows that priority could be claimed by E. Schweidler in his discussion of the Pellat theory. The identity of the two results is shown. S. G. B.

2388. *Index of Refraction and Dielectric Constant of Water Vapour.* **A. Bramley.** (Frank. Inst., J. 203. pp. 701–711, May, 1927.)—Follows up an investigation of the dielectric constant of bromine [see Abstract 1874 (1927)] experimentally and mathematically. The variation of the index of refraction of water vapour with the voltage applied to a cylindrical condenser was proportional to the square of the electric intensity as the author had predicted. The electrostriction effect is unable to account for this. A. D.

2389. *Direct-Current Potential Transformer.* **P. B. Carwile.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 323–327, April, 1927.)—This transformer, which operates electrostatically, is so devised that it manipulates the connections of a direct-current source and n condensers and gives a potential difference equal to the original value multiplied by 2^n. Three essential principles are involved: (1) a number n of condensers and a commutator are arranged so that the condensers are charged in parallel to a voltage V, and discharged in series to give a voltage nV; (2) the charged condensers are put in series with one another and with the source to give a cumulative voltage of $(n + 1)$V; (3) the condensers are grouped and the grouping arranged for a maximum terminal voltage. A diagram illustrates the mechanical device used to embody these principles, and tests of the apparatus confirm the theoretical reasoning. R. S. R.

2390. *Quadrant Electrometer.* **J. F. Sutton.** (Journ. Sci. Instruments, 4. pp. 226–232, April, 1927.)—The advantages of the electrostatic over the dynamometer method for the measurement of electric power and also some of the difficulties arising with the former method are outlined. A brief description is given of the features of earlier standard electrometers used at the Reichsanstalt and the National Physical Laboratory. The essential conditions for the design of an instrument having a straight line law are mentioned and some existing devices to meet these requirements are criticised. Finally a design is given of a suitable commercial instrument possessing the maximum degree of accuracy and the minimum of adjustments. R. S. R.

2391. *Kirchhoff's Bridge.* **M. N. States.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 328–331, April, 1927.)—The author describes a form of apparatus which is primarily a resistance box, while with the addition of three 100-ohm coils and auxiliary connections a considerable variety of three-mesh circuits is possible. The laboratory exercise involves the theoretical and experimental analysis of such a circuit. The arrangement furnishes the instructor with a quick check on the student's work. The figure of merit of a galvanometer may be quickly obtained with this arrangement. R. S. R.

2392. *Bridge for Measurements with Direct Current.* **C. Drucker.** (Zeits. Elektrochem. 33. pp. 150–152, April, 1927.)—Description of an arrangement suitable for measurements of resistance, conductivity and e.m.f. A calibrated wire of constantan 20 cm. in length is used with a shunt of the same material, in combination with a set of coils of various resistances. High accuracy is obtainable and the sensitiveness can be varied. J. J. S.

2393. *Bridge for the Measurement of Self-Inductances.* **C. Günther.** (Zeits. Instrumentenk. 47. pp. 249–256, May, 1927.)—A modification of the bridge recently described by the author [Abstract 1525 (1927)], in which, by the introduction of suitable resistances into the arm containing the unknown self-inductance, the range of measurement may be extended without the need of providing additional condensers in the branch containing the capacity against which the unknown self-inductance is compared. A single adjustable condenser of the usual commercial type having a capacity up to 1000 cm. is provided, and—in order to facilitate working in certain cases—a condenser having a fixed capacity of 500 cm., which may if necessary be connected in parallel with the variable condenser. A. H.

2394. *A Vacuum Tube Potentiometer.* **A. L. Fitch.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 348–353, April, 1927.)—In his book " The Thermionic Vacuum Tube " van der Bijl discusses a circuit which with suitable modifications becomes one of the most versatile of electrical measuring circuits. He uses it to measure the amplifying power of vacuum tubes under varying conditions. As modified, it is essentially a vacuum tube voltmeter circuit, and may be used wherever electrical quantities may be measured by equating potential drops. Two special circuits are here described and illustrated diagrammatically, the single tube potentiometer and the double tube potentiometer; the latter is a little difficult to adjust, but once adjusted readings may be taken very rapidly. A. E. G.

2395. *Gyroscopes.* **A. de Gramont.** (Comptes Rendus, 184. pp. 1050–1051, May 2, 1927.)—An arrangement is described for feeding a gyroscope with alternating current through its axes of suspension. The gymbal ring is in two halves separated by insulating material, and monophase current is supplied to the two axes of suspension of this ring and thence by means of the axes of the gyroscope to the stator windings of the squirrel-cage motor. In one arrangement giving two-phase operation the current between the two gyroscope axes, that is, through the stator windings, goes through two coils sensibly at right angles to one another but of different impedance, a condenser being in series with one branch. A phase difference of nearly $\pi/2$ is obtained in the two branches, and the apparatus works as if the gyroscope were fed with two-phase current by means of four wires. With three branched circuits instead of two and suitable phase-shifting devices the equivalent of a three-phase system may be obtained. In both cases the perturbations due to the usual connecting wires are avoided. A. W.

2396. *Synchronous Alternating Current Motor and Mechanical Vibrating System maintained by a Thermionic Valve at the Frequency of the Vibrating System.* **T. G. Hodgkinson.** (Phys. Soc., Proc. 39. pp. 203–221; Disc., 221–222, April, 1927.)—The design of a chronograph which will give a time trace subdivided into units and fractional units requires the association of a rotating system and a vibrating or time-keeping system. If a low-frequency system be employed, the rotating system, although keeping good average time, may show exaggerated errors in unit subdivisions due to acceleration and deceleration between periods of control. The author discusses the association of a high-frequency synchronous a.c. motor with a high-frequency valve-maintained tuning fork. He deals with the design of valve-maintained motors and condenser-tuned valve-maintained tuning forks, and gives expressions for frequency of the maintained system for motors coupled to tuning forks both without and with tuning condensers. In the *Discussion*, **D. Owen** asked whether the mechanical amplitude of the fork had been measured directly as distinct from the anode current, for amplitude and frequency in this case were not independent. The author replied stating what measurements had been made. R. S. R.

2397. *Standard Frequency and Frequency Measurement. Parts I and II.* **A. Scheibe.** (Zeits. f. Hochfrequenztechn. 29. pp. 120–129, April, and pp. 158–162, May, 1927.)—Part I deals with various methods used in the production of standard frequency. These may be classified into (1) various methods employing valve-maintained tuning forks; (2) transmitters giving discreet standard frequencies; (3) transmitters having continuously variable frequencies; and (4) the quartz oscillator. A summary of the various experimental arrangements which have been used is given. Part II deals with the measurement of frequency, taking, as particular cases, (1) audible frequency, (2) intermediate frequency, and (3) high frequency. An extensive bibliography appears as an appendix to this part. G. E. B.

2398. *Electrical Measurements at Radio Frequencies.* **S. L. Brown** and **M. Y. Colby.** (Phys. Rev. 29. pp. 717–726, May, 1927.)—Resistance, inductance, capacity, and impedance are measured at radio frequencies with the aid of a vacuum-tube voltmeter. By a slight modification of the resistance-variation method, resistances of the order of $0{\cdot}01\Omega$ are measured with an accuracy of 1 %. The same accuracy is obtainable with inductances of only a small fraction of a micro-henry using the ammeter-voltmeter method. Capacities are measured with high accuracy by tuning a low resistance circuit with and without the unknown capacity in parallel with a standard condenser. The high accuracies are obtainable by using (*a*) low resistance circuits, (*b*) negligible power from the oscillator and (*c*) a sensitive voltmeter [see Abstract 2453 (1926)]. E. T. A. R.

2399. *Determination of the Power-Voltage Characteristic of a Siemens Ozoniser.* **R. W. Lunt.** (Phil. Mag. 3. pp. 1025–1031, May, 1927.)—In experiments on the chemical changes arising from the ionisation by collision produced in a gas when subjected to single-phase alternating electric fields applied by means of a Siemens ozoniser, it is frequently necessary to determine the power consumed in the ionised gas. The power to be determined is of the order of 10–50 watts for ozonisers of laboratory dimensions operated in the range of commercial frequencies. There are five methods available for the measurement of this power. One of these methods, that introduced recently by Becker, has the advantage of being relatively inexpensive and simple in use. The description of the method given by Becker is somewhat meagre; in addition, the corrections applied and the precautions enumerated would appear to be inadequate. In this paper an attempt is made to give a more complete analysis of the factors involved in the method, together with a description of the appropriate technique. [See also Abstract 2477 (1926).] A. E. G.

ALTERNATING CURRENTS AND MAGNETISM.

2400. *Resonance in Alternating Currents Containing a Single Harmonic.* **F. H. Miller.** (Phys. Rev. 29. pp. 546–553, April, 1927.)—Some current-frequency relations as affected by the presence of harmonics in the voltage wave are investigated for the case in which one harmonic of order n is present in the applied e.m.f. *Series Circuit.*—The form of a current-frequency curve depends only upon the ratio $K = R^2C/L$ (called the " resonance factor ") and the ratio a of the harmonic to the fundamental e.m.f. amplitude. Special cases are considered, especially the third harmonic, and a method for plotting generalised current-frequency curves is outlined. *Parallel Circuit.*—The current-frequency curve has only one minimum, regardless of the number of harmonics, but the position of the minimum point is dependent upon the number and amplitude of the harmonics present. For each circuit an experimental method is given for determining the amplitudes of the fundamental and harmonic in an e.m.f. wave. J. J. S.

2401. *Tyndall's Experiments on Magne-Crystallic Action.* **W. Bragg.** (Nature, 119. pp. 61–72, May 7, 1927. Supplement. Lecture delivered at the Royal Inst., Jan., 1927.)—The experiments of Plücker in 1847 directed attention to the peculiar behaviour of crystals in a magnetic field. In the field of an electromagnet with pointed pole-pieces a crystal sets itself equatorially when the poles are close, but axially when the poles are separated. This effect was called by Faraday magne-crystallic action. He distinguished the paramagnetic substance from the diamagnetic by their actions in respectively concentrating and dispersing the lines of the field. In addition, a magne-crystallic substance is one which permits the exertion of the magnetic force with more facility in one direction than in another. A third variable in crystals is the shape, and a fourth is the distribution of intensity and direction of the field. Apart from magne-crystallic action, a diamagnetic bar would tend to set itself along the lines of force. This was pointed out by Sir William Thomson in 1885, but has never been demonstrated, although its electrostatic analogue is capable of realisation. The experiments of Tyndall and Knoblauch, published in 1850, led them to conclude that in a crystal the line of closest proximity of the molecules is that chosen by the respective forces for the exhibition of their energy. If the mass be magnetic, this line will set itself axially; if diamagnetic, equatorially. The molecules in a crystal were supposed to lie closer to each other along a cleavage plane than in any other direction. It is pointed out by the author that there is no clear meaning to the phrase " greater proximity in the cleavage plane." Whilst Tyndall's experiments must be held to have failed in their original purpose, they can be turned to a different use, and are closely related to a modern research, that of the effect of stress on the constitution and physical properties of materials. The author concludes that we are still far from the full explanation of the connection between structure and magnetism and of the influence of the latter on physical properties.
G. E. A.

2402. *New Method of Exploring the Magnetic Field. Confirmation of the Axial Effect.* **L. Sesta.** (N. Cimento, 4. pp. 125–131, May, 1927.) —The paper is in two sections. The first deals with a method of exploring a magnetic field based on the measurement of the Hall effect in a lamina of bismuth of very small dimensions. This method was applied to the study of magnetic fields in which la Rosa and Sellerio [Abstract 1208 (1920)] observed the new galvanomagnetic effect which they called axial. The second confirms the presence of the axial effect in a magnetic field free from iron, perfectly uniform, generated by a coil of suitable dimensions. The result of both researches is to disprove the contention that the axial effect is due to a want of uniformity in the magnetic field. E. F.

2403. *Magnetic Permeability of Iron and Magnetite in High-Frequency Alternating Fields.* **G. R. Wait.** (Phys. Rev. 29. pp. 566–578, April, 1927.)—The relative values of the permeability of cast-iron filings, iron wires, and iron powder in high-frequency magnetic fields were investigated. The resonance method and the heterodyne method were used. Both utilise in principle the measurement of the change in inductance of a coil due to the introduction of the sample of material into it. The wave-length ranges covered were from 80 to 1700 metres by the heterodyne method and from 50 to 160 by the resonance method. No anomalous change in permeability was found at any frequency. Various sources of error which may have misled previous investigators are mentioned. The absolute value of the permeability of powdered magnetite was measured by two fairly independent methods. The values decrease from about 1·532 at 132·2 metres to 1·401 at 85·8 metres. J. J. S.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2404. *New Phenomena of Secondary Radiation and their Importance for Radiotherapy.* **W. Friedrich.** (Brit. J. of Radiology, 23. pp. 102–111; Disc. 112, April, 1927.)—A simple description of the Compton effect is given. Experiments are described and data given of absorption determinations which indicate that a change of wave-length of secondary radiation occurs when radiation is utilised as in radiotherapy. This change may be due to the production of a non-characteristic secondary radiation, as described by Duane, or to the Compton effect. The results show that the obtainance of a homogeneous radiation, as hitherto proposed for deep therapy, is impossible owing to this change of wave-length. B. J. L.

2405. *A Universal Constant-Tension X-Ray Machine for Diagnostics and Therapy.* **M. Brenzinger, F. Dessauer** and **E. Lorenz.** (Brit. J. of Radiology, 23. pp. 184–191, April, 1927.)—A description in detail of a machine working with any deep therapy tension, but also producing such tensions and currents as are used in diagnostic work. The apparatus consists of a series of unit cells, each containing a transformer, two kenatrons and two condensers, and capable of yielding 25 kV and 30 mA continuously. By connecting together a number of such units, voltages up to 225 kV may be obtained, and it is claimed that the apparatus produces practically uniform tensions over wide limits with Coolidge tubes. W. V. M.

2406. *High-Tension Generators giving approximately Constant Voltages.* **H. Moore.** (Brit. J. of Radiology, 23. pp. 192–197; Disc., 197–198, April, 1927.)—The author reviews the advantages of constant-tension apparatus and considers that the most important one is the elimination of the differences between the conditions in different X-ray sets owing to differences in wave-form in the secondary. He then describes a generator having mechanical "rectification" of a type enabling three-phase current to be used and converting high-tension three-phase current into unidirectional current at an approximately constant voltage. W. V. M.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2407. *Principle of Displacement in Liquid Solutions.* **D. Reichinstein.** (Zeits. Elektrochem. 33. pp. 122–127, April, 1927.)—The principle of displacement in liquid solutions was examined theoretically in the cases of lowering of vapour pressure and lowering of solubility. Some of the equations are simplified, and the results given by them were compared with the results of experiment. The results were summarised and the new unsolved problem of the action of "poisons" or ballast actions was outlined. F. J. B.

2408. *Solubility of the Rare Gases in Water.* **S. Valentiner.** (Zeits. f. Physik, 42. 4. pp. 253–264, 1927.)—The solubilities of radium emanation, helium, neon, argon, krypton, and xenon in water were determined. The solubilities of helium and neon in water diminished from 0° C. with rising temperature, and showed a minimum solubility at about 80° C. The other rare gases showed a similar minimum. The dependence of the solubility on the temperature is given by the equation

$$T^2 d \log l/dT = a_0 + a_1 t,$$

or

$$\log l = 273 a_1 - a_0/T = 2\cdot 3 a_1 \log T + a_2,$$

in which the constants a_0, a_1 and a_2 are approximately proportional to the square root of the atomic weights. Argon and krypton are considered to form hydrates, and it is probable that the other rare gases also form hydrates. F. J. B.

2409. *Determination of the Size of Particles in Colloidal Solutions.* **H. J. C. Tendeloo.** (Kolloid Zeits. 41. pp. 290–293, April, 1927.)—The effect of solutions of KCl of different concentrations upon the viscosity of the sol of arsenic trisulphide was investigated. It was found that the viscosity was increased by the addition of the electrolyte and reached a maximum. The results obtained were in agreement with the theory of Smoluchowski that the influence of electrolytes was a capillary electrical effect. This was shown to be the case for lyophile colloids. The results further showed that it is possible to calculate the mean size of the particles by means of v. Smoluchowski's formula if the viscosity, the conductivity, the electro-kinetic potential, and the relative volume are known. F. J. B.

2410. *Problem of the Surface Tension of Mercury and the Action of Aqueous Solutions of a Mercury Surface.* **R. S. Burdon** and **M. L. Oliphant.** (Faraday Soc., Trans. 23. pp. 205–213, May, 1927.)—The drop-weight method fails entirely to reveal differences between the values of the surface tension of mercury in air and vacuum, although such differences are shown by the fact that a "large drop" of mercury is always deeper when formed in air than when formed in a vacuum [see Abstract 2413 (1925)]. The drop-weight method depends on the assumption that the capillary rise method gives the correct value for the surface tension of water, but the fact that values differ with the kind of glass used for the tube requires explanation. Moreover, this method is based on measurements of liquid drops of approximately unit density which hang from the outer circumference of the tube, and there seems to be little experimental belief that drops will have the same form for liquids of high density that do not wet the tube. As yet the big drop method is the simplest for following changes of surface tension, but it is not possible to take a reading for some seconds after the drop is formed. The results of further experiments [see Abstract 1198 (1926)] on the spreading of aqueous solutions on mercury, on the one hand, suggest the existence of forces exerted over greater than molecular distances, and, on the other hand, support the view that the ion is the determining factor in the spreading of these liquids. [See also Abstract 1189 (1927).] T. H. P.

2411. *Corrosion of Metals at Joints and Crevices.* **U. R. Evans.** (Roy. Soc. Arts, J. 75. pp. 544–562; Disc., 562–567, April 29, 1927.)—Apart from the influence exerted by the contact of two dissimilar metals, a frequent cause of corrosion is due to differences in the degree of aeration of different parts of a solution surrounding a metal. Differential aeration cells are in this way formed in crevices or pores of a metal or under parts screened locally by some foreign matter from contact with air. In these cells the " unaerated " electrode forms the anode or corroded pole, and in a cavity corrosion will burrow down, enlarging and deepening the hollow. In selecting materials which are to come into contact at a joint, it is in some cases advisable to make the metal presenting the smaller area weakly kathodic to the other. The most dangerous condition is a capillary crevice existing between two dissimilar metals. J. N. P.

2412. *Second Experimental Report to the Atmospheric Corrosion Research Committee (British Non-ferrous Metals Research Association).* **W. H. J. Vernon.** (Faraday Soc., Trans. 23. pp. 113–185; Disc., 185–204, April, 1927.)—In this report the arrangement of the matter differs from that previously adopted [Abstract 2617 (1924)], the indoor exposure tests and the laboratory experiments being grouped together. The metals investigated comprise copper, zinc, brasses, aluminium, lead and iron. It is found that conclusions which hold good for a given set of conditions do not necessarily apply when those conditions are changed, this being well exemplified by the influence of impurities in copper. Indoors, under conditions such that only tarnishing has to be considered, a given element exercises an effect which is either negligible or in simple proportion to the amount of the element present. When, however, the metal is exposed to the open air, the same element may exert an effect out of all proportion to its concentration. It would appear that protection against indoor tarnishing should be sought by means other than modification of composition alone, and promising results have been obtained by the formation of protective surface films. In the indoor exposure and laboratory tests the experiments made include inquiry into the effect on tarnishing of surface condition, chemical cleaning, purity of the metal, and humidity and sulphur content of the atmosphere; into the composition and mechanism of formation of tarnish films; into the formation of protective oxide films at various temperatures; into the protective effects of smoke films, and into protection by other means. Detailed results are given for each of the metals. The open-air exposure experiments comprise intensive tests on specimens of copper, 70 : 30 and 60 : 40 brasses, and zinc, in various physical conditions. Results are given of periodical analyses of the rain-water collected from beneath the specimens. As regards the dependence of the weight of metal removed on the period of exposure, a linear relationship is exhibited for the whole time in the case of copper and for the major part of the time with the other metals. The order in which the metals are affected by this attack, *i.e.*, erosion, is: zinc (most), 70 : 30 brass, 60 : 40 brass, copper (least). The soluble products formed from the brasses exhibit excessive preponderance of zinc over copper. From the weight of metal removed and the initial and final weights of the specimen, a value is obtained for the "surrosion," represented by the residual products adhering to the specimens; analyses have been made of such products in all cases. The order of surrosion is 60 : 40 brass, 70 : 30 brass, copper, zinc, whilst that of corrodibility, calculated from the sum of erosion and corrosion, is: 60 : 40 brass, 70 : 30 brass, zinc, copper. Tests on various metals exposed for over four years reveal the following figures for the total corrosion, that of high conductivity copper being taken as 100 :—

Copper with 0·45 % of arsenic	43
Copper with 2·5 % of nickel	61
Copper with 0·8 % of tin	76
Ordinary copper	81
70 : 30 brass	140
Zinc	155
60 : 40 brass	227

In connection with the high resistance to corrosion displayed by arsenical and nickeliferous coppers, it is pointed out that, of the copper materials, these showed the most rapid loss of reflectivity during the first few days of the exposure. The importance of diffusion in atmospheric tarnishing is emphasised. Copper might tarnish readily when suspended free in a room, and yet remain bright indefinitely and slowly develop a protective oxide film if enclosed in a bell-jar. T. H. P.

2413. *Formation of Mixed Crystals by Contact of Solid Phases and by Precipitation from Solutions.* **L. Vegard** and **T. Hauge.** (Zeits. f. Physik, 42. 1. pp. 1–14, 1927.)—The formation of mixed crystals by the contact of solid phases was investigated for the system KBr-KCl. Elaborate precautions were observed in order to exclude moisture. A similar result was obtained for the system HgBr-HgCl. The results lead to the conclusion that crystal lattices in contact can exchange atoms. The metal system Au-Cu did not yield any mixed crystals when subjected to friction and hammering for some hours. A small increase in size of the copper lattice indicated that the copper lattice had taken up some gold atoms. The system HgCl-HgBr formed mixed crystals when subjected to friction, but not to the same extent as with KCl-KBr. A solution of HgNO on precipitation with a solution of KCl and KBr yielded homogeneous mixed crystals of HgCl-HgBr, whose composition depended on the precipitating solution. F. J. B.

2414. *Action of Salts upon Metals.* **T. Peczalski.** (Comptes Rendus, 184. pp. 1159–1161, May 16, 1927.)—Copper and iron, heated in the presence of salts, are found to give rise to three distinct phenomena, *viz.*: (1) Increase of volume, which is accompanied by increase of electrical resistance. This phenomenon is produced when the metal and salt do not interact. (2) Cementation, which occurs when the salt is decomposed by the metal, *e.g.*, when copper is heated in NaCl, $CaCl_2$, $NiCl_2$, and $CrCl_3$; the action is promoted by the volatility of the salt. (3) Fusion effects: experiments are described with illustrations showing the effect on copper rods heated in vapours of $CrCl_3$ at 800° C., when a fusion at the surface of the rod is observed, due either to vapour absorption with rise of temperature or to formation of a volatile chemical compound with disengagement of heat. The above observations are useful for the explanation of certain facts of thermionic emission. H. H. Ho.

2415. *Bismuth Wire.* **D. C. Stockbarger.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 445–447, May, 1927.)—Gives details of a method found successful for the extrusion of bismuth wire, together with a diagrammatic sketch of the press used. The wire produced is sufficiently pliable to be wound round a ⅛-in. rod and straightened out again. The wire can be extruded at room-temperature, but less pressure is required when the press is heated, and wires made at temperatures from 25° C. to 100° C. have proved satisfactory mechanically. C. O. B.

2416. *The Parachor and Chemical Constitution. Part V. Evidence for the Existence of Singlet Linkages in the Pentachlorides of Phosphorus and Antimony.* **S. Sugden.** (Chem. Soc., J. pp. 1173–1186, May, 1927.)—The parachors of phosphorus and antimony pentachlorides are estimated to be 26 units below the sum of the atomic constants. Three formulæ for the structure of these substances from the standpoint of the electronic valency theory are discussed and the effect of each upon the parachor is deduced by the aid of the relation between the parachor and the number of electrons in a linkage. The formula of Prideaux, in which two singlet linkages are present, is considered to give the best and simplest explanation of the observed anomaly. The parachor can therefore be used to detect the presence of such linkages, since each singlet linkage contributes − 12·4 units to this molecular constant. The electronic theory is extended to include linkages composed of odd numbers of shared electrons. The modified theory has been applied to deduce formulæ for the higher halides of Groups V, VI, VII and VIII for borethane, nitric oxide, chelate groups, coordination compounds, and for a number of "molecular compounds." [See also Abstract 1558 (1927).] J. N. P.

2417. *Burning of Carbon Disulphide near the Limit for the Propagation of Flame, with Some Remarks on the Ignition Point of Sulphur.* **A. G. White.** (Chem. Soc., J. pp. 793–802, April, 1927.)—The previous results [Abstract 387 (1923)] are extended. With carbon disulphide-air mixtures, in which part of the air is replaced by a third (combustible) substance, the two combustibles present sometimes appear to burn separately, as two flames are obtained touching only near the axis of the tube. This is well marked with the mixture containing 7·9 % of carbon monoxide. The results are in general agreement with those of former work, and indicate that the addition of a small proportion of one of a large variety of substances raises the value of the lower limit for carbon disulphide air. The large difference previously noted between the behaviour of gases and that of certain vapours is now seen to have been due in part to the choice of gases, and in part to the small quantities of these that were used. The added substances appear to act in three ways: (1) They alter the thermal constants of the mixture; (2) they alter the percentage of oxygen in the mixture; (3) they produce what may be termed a specific catalytic effect. These various effects are discussed.

T. H. P.

2418. *Investigation of Gaseous Explosions. Part II. Ionisation in Detonating and Non-Detonating Mixtures of Hydrogen and Oxygen.* **S. W. Saunders.** (Faraday Soc., Trans. 23. pp. 242–248, May, 1927.)—In a previous paper [see Abstract 511 (1927)] it was shown that the electrical conductivity of the hot gases produced by the explosions of hydrogen and oxygen is caused mainly by the ionisation of the molecules in the gaseous mixture. The work was continued and it was shown that the current passing between electrodes placed at the centre of a spherical bomb of nearly 2 litres capacity, when different mixtures of hydrogen and oxygen were fired in it by ignition at the ends of firing tubes of different lengths screwed into its walls, can be represented by the equation $C = C_0 + Ad$, where A and C_0 are constants for any given mixtures each having a maximum value for the mixture $2H_2 + O_2$. The effects of "anti-knocks" and "knock inducers" were investigated and were found to be without influence on the final stages of the gas mixture.

F. J. B.

2419. *Investigation of Gaseous Explosions. Part III. Ionisation in Explosions of Carbon Monoxide and Oxygen.* **S. W. Saunders** and **K. Sato.** (Faraday Soc., Trans. 23. pp. 248–256, May, 1927.)—The ionisation of the explosion of dry carbon monoxide and oxygen was studied by means of the electrical conductivity. The results confirmed the view that the ionisation in gaseous explosions was mainly thermal in character. The addition of hydrogen or water to the dry carbon monoxide and oxygen mixtures increased the ionisation produced during explosion. The conductivity of the gases produced during the explosion changed in an analogous manner to the velocity of propagation of the explosion wave. The duration of the ionisation in the explosion of dry carbon monoxide-oxygen mixtures was found to be much greater than for the moist gases. This is in agreement with the slow development of pressure which occurs in explosions of dry carbon monoxide and oxygen in closed vessels.

F. J. B.

2420. *Investigation on Gaseous Explosions. Part IV. Ionisation in Methane-Oxygen and Acetylene-Oxygen Explosions.* **S. W. Saunders.** (Faraday Soc., Trans. 23. pp. 256–266, May, 1927.)—Continuing the work detailed in Parts I, II, and III [see preceding Abstracts and 511 (1927)], the explosions of mixtures of methane and oxygen, acetylene and oxygen were studied and the results showed that the electrical conductivity reached a maximum value when the hydrogen was burnt to water and the carbon to carbon dioxide in the former case, and when the hydrogen was burnt to water and the carbon to monoxide in the latter. When 70 % of nitrogen was added to the acetylene-oxygen mixtures, the maximum temperature of explosion was lowered sufficiently for the combustion of carbon monoxide to dioxide to occur in the mixtures giving the greatest electrical conductivity. The conclusion that the ionisation is a thermal and not a chemical effect was confirmed. It was shown that there is probably no connection between ionisation during explosion and the ignition temperature of the initial mixture of gases. F. J. B.

2421. *Analysis of the Time Laws of Chemical Reactions.* **M. Bodenstein.** (Ann. d. Physik, 82. 6. pp. 836–840, April 4, 1927.)—This paper is a defence against Skrabal's recent criticism [see Abstract 1576 (1927)] of Herzfeld's mathematical treatment of the formation of hydrogen bromide from its elements, which was based on data by Bodenstein and Lind. The author treats the subject generally, and shows Skrabel's deductions to be really based upon the same considerations as those employed by Herzfeld. The paper should be consulted in its entirety. H. H. Ho.

2422. *Decomposition of Carbon Monoxide in the Corona due to Alternating Electric Fields. Part II.* **R. W. Lunt** and **R. Venkateswaran.** (Chem. Soc., J. pp. 857–867, April, 1927.)—Using the same electrical technique as described in a previous paper [see Abstract 198 (1926)], a further quantity is prepared of the brown solid produced when CO is subjected to ionisation by collision produced by alternating electric fields of frequency 250 cycles per sec., at pressures from 200 to 690 mm. Hg. A preliminary quantitative investigation shows that, after removal from the reaction vessel, the substance has the empirical composition C_5O_3, xH_2O. The substance reacts with water, forming CO_2, a brown solution containing $(COOH)_2$ and colloidal particles, and a dark, insoluble residue. A. B. C. L.

2423. *Molecular Induction in Relation to Activation by Bombardment.* **J. Perrin** and **(Miss) Choucroun.** (Comptes Rendus, 184. pp. 985–987, April 25, 1927.)—In continuation of the study of the effect on the reaction between glycerine and methylene blue (typical of a fluorescent substance) of light which excites the fluorescence [see Abstract 250 (1927)], it is found that, contrary to expectations theoretically deduced, the law of mass action only holds for an activated substance by thermic means, even in the limit of concentration where the molecular induction reduces to a considerable extent the mean life in the excited condition. An extensive selective sensitivity is indicated between molecules of the same class or, more generally, between isochronous molecules. A. B. C. L.

2424. *Photovoltaic Elements with Glycerine.* **A. Grumbach.** (Comptes Rendus, 184. pp. 169–171, May 16, 1927.)—Comparing a photovoltaic element with a fluorescent liquid to another element containing the same active body, but having glycerine in the solution, it is found that the latter shows an increase in the e.m.f. Glycerine and its solutions being fluorescent, the author experimented in the first place with a battery composed of platinum-glycerinated water-platinum. One of the electrodes was illuminated by the radiations of the mercury arc passing through the water and the glass, the illumination lasting five minutes. A table is given showing in millivolts the Becquerel effect B and the electromotive adsorption force A for concentrations varying from 692 to 19·1 grammes of glycerine per litre. B attained a maximum of 9·8 with a concentration of 47 gm. and A a maximum of 10 with 188 gm. per litre. The electromotive forces A and B have here the same negative sign. In the case of glycerinated solutions of potassium chloride the two effects are positive, and the path of the curves showing them as a function of the glycerine concentration is different. For example, with a solution containing 24·6 gm. of glycerine and 25·8 gm. of potassium chloride per litre B = + 1·1 mV, A = + 11·3 mV. Glycerinated water at 692 gm. and a solution of fluorescein at 0·0082 gm. per litre are both inactive. On the other hand, a solution containing the same proportions both of glycerine and fluorescein gives an electromotive adsorption force of + 17·3 mV. The Becquerel effect, imperceptible with this concentration, is apparent with a negative sign in solutions stronger in glycerine but containing the same proportion of fluorescein. The opposite signs here observed are identical with those of the e.m.f. of batteries with a solution of fluorescein in pure water without the addition of alkali.

E. F.

2425. *Silver Accumulator.* **F. Jirsa.** (Zeits. Elektrochem. 33. pp. 129–134, April, 1927.)—An accumulator is formed by the chain Ag/NaOH/Fe, the anode consisting of silver sponge compressed at high pressure on to the surface of a fine nickel wire gauze, and the kathode of pulverised iron made into a paste with gum arabic and compressed on to an iron gauze. The electrodes are ignited after drying. With a charge and discharge rate of 0·0011 amp./cm.^{2} a current efficiency of 95·5 % and an energy efficiency of 68·4 % is obtained, while the capacity of the accumulator amounts to 269 watthours for 1 kg. of anode mass. On open circuit the electrode potential corresponding to the first oxidation stage Ag_2O is 1·17 and that of the second stage Ag_2O_2 is 1·47. During charging deterioration is brought about by diffusion of Ag_2O_2 to the kathode through cataphoretic action. This effect is caused by the presence of carbonate and is lessened by the addition of potassium sulphate.

J. N. P.

2426. *Electrical Polarisation in Selenium Cells.* **A. O. Rankine** and **J. W. Avery.** (Phys. Soc., Proc. 39. pp. 187–201; Disc., 201–202, April, 1927.)—Secondary e.m.f.'s were observed in certain selenium cells after the passage of electric currents through them, and the polarisation voltage was very largely diminished by illumination. The secondary current also became less under the action of light in contrast with the well-known enhancement of current by illumination when the selenium cell is used in the ordinary way. Observation of the effect of phosphorus pentoxide upon the cell led to the conclusion that the behaviour of the cells can be accounted for satisfactorily on the assumption that the polarisation observed was not due to the selenium itself, but to something in the nature of a water film, removable by persistent drying, in parallel with the selenium between the electrodes of the cell. This was confirmed by various experiments. An important practical result is the fact that the light sensitiveness of the selenium cells is greatly increased by desiccation.

J. J. S.

2427. *Potentiometric Differential Titration.* **W. A. Roth.** (Zeits. Elektrochem. 33. pp. 127–129, April, 1927.)—A simplification of the differential potentiometric titration was made by utilising the glass crucibles with the glass filter bottoms as the electrolytic contact, and which were applicable to all forms of electrodes. Results of neutralisation and precipitation experiments were given in support of the general applicability of the method. F. J. B.

2428. *Passivity of Metals. Part I. Isolation of the Protective Film.* **U. R. Evans.** (Chem. Soc., J. pp. 1020–1040, May, 1927.)—The alteration in chemical properties of iron and other metals by oxidising treatment has been attributed to the formation of a protective film of oxide, oxygen alloy, or other material, or to essential changes in the metal itself, or to the removal of a supposed catalyst. The existence of the protective film was investigated, and it was shown that passive iron is covered with a film which is too thin to give interference tints, but which can be removed and so rendered visible by dissolving away the metal below it by anodic treatment, or by means of iodine. The film is the cause of the passivity where the film is discontinuous or contains cracks, the iron is active. Passive iron is activated by chlorides, since chlorine ions can pass through the skin. The film becomes readily loosened at the water level. Flakes of passive copper and aluminium have been obtained. The passivity of copper was found to be less persistent than that of iron, but the passivity of aluminium was more persistent than with iron. F. J. B.

2429. *Anodic Behaviour of Metals in Non-Aqueous Solutions.* **M. Sborji.** (Accad. Lincei, Atti, 5. pp. 571–575, April 24, 1927.)—In an alcohol solution of sodium or ammonium chloride, cadmium, when employed as anode during electrolysis, dissolves in excess of the amount corresponding to its electrochemical equivalent except when at a low temperature of − 10° C. The amount of this chemical solubility, in addition to the electrochemical solubility, increases with temperature. In alcoholic solutions of ammonium nitrate, the excess of solubility is much more pronounced, particularly at low current densities, and the values are of the same order as those obtained in aqueous solutions. The metal dissolves appreciably in alcoholic ammonium nitrate in absence of any current. [See Abstract 2189 (1927).] J. N. P.

2430. *Periodic Electrodeposition of Metals through Secondary Reaction.* **E. S. Hedges.** (Chem. Soc., J. pp. 1077–1087, May, 1927.)—Periodic changes in the kathode potential and current strength occur between certain limiting current densities during the electrolysis of solutions composed of a mixture of mercuric chloride or mercurous nitrate with solutions of the salts of alkali metals, alkaline earths, or aluminium, and in solutions of mercuric cyanide or cadmium cyanide in potassium cyanide. The phenomenon consists of the alternate deposition of two metals, and has been observed only when one of the metals is deposited through a secondary reaction. The values of the limiting current densities, between which the region of periodicity exists, depend on the relative amounts of the components of the mixed solution. Periodicity has been realised where the amount of metal deposited in each period does not exceed a few molecules in thickness. J. N. P.